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A microcomputer based shipboard surface-subsurface contact plotter system Pt.2

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Monterey, California. Naval Postgraduate School

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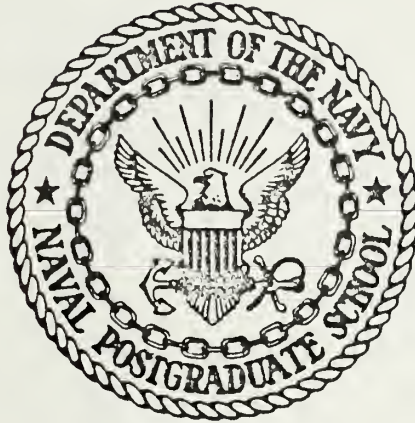
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A MICROCOMPUTER BASED SHIPBOARD
SURFACE-SUBSURFACE
CONTACT PLOTTER SYSTEM.
PT.2

Antonio Luiz Soares Goncalves

NAVAL POSTGRADUATE SCHOOL

Monterey, California



THESIS

A MICROCOMPUTER BASED SHIPBOARD
SURFACE-SUBSURFACE CONTACT PLOTTER SYSTEM

by

Antonio Luiz Soares Goncalves

"

and

Javier Enrique De la Cuba Bravo

June 1978

Lpt 23

Thesis Advisor:

Stephen T. Holl

Approved for public release; distribution unlimited.

U184180


```

/*****
*
* INPUT$TIME:
* THIS PROCEDURE IS USED TO ALTER ALL VALUES CONCERNING WITH TIME:
*   - TIME ZONE NUMBER.
*   - SYSTEM CLOCK TIME.
*   - TIME BETWEEN UPDATES OF OWN SHIP POSITIONS.
*
* USAGE:
* TYPED PROCEDURE. IF THE TIME BETWEEN UPDATES IS CHANGED (DEFAULT 180 SEC-
* ONDS) THEN THE NEW VALUE IS RETURNED, OTHERWISE A VALUE OF ZERO IS RETUR-
* NED. THE VALUE MUST BE BETWEEN 250 AND 15.
*
*****/
INPUT$TIME: PROCEDURE BYTE PUBLIC;
DCL ARRAY(3) BYTE,
VALUE ADDRESS,
(I, OK, TEMP) BYTE;
DCL M0 (*) BYTE DATA ('TIME ZONE NUMBER? (Y/N) $$'),
M1 (*) BYTE DATA ('SYSTEM CLOCK VALUE? (Y/N) $$'),
M2 (*) BYTE DATA ('TIME BETWEEN UPDATES? (Y/N) $$'),
M3 (*) BYTE DATA ('ENTER TIME BETWEEN UPDATES AS REQUESTED: $$'),
M4 (*) BYTE DATA ('SECONDS: $$'),
M5 (*) BYTE DATA (' *** BAD FORMAT ***$$');

OK = 0;
DO WHILE OK = 0;
CALL CRT$PRINT$STRING(, TITLE$6);
CALL SEND$CRLF;
CALL CRT$PRINT$STRING(, MSG$1);
CALL SEND$CRLF;

```



```

CALL CRT$PRINT$STRING(.M0);
ARRAY(0) = CHECK$YES$NO;
CALL SEND$SPACE(13);
CALL CRT$PRINT$STRING(.M1);
ARRAY(1) = CHECK$YES$NO;
CALL SEND$CRLF;
CALL CRT$PRINT$STRING(.M2);
ARRAY(2) = CHECK$YES$NO;
CALL SEND$CRLF;
OK = CHECK$INPUT;
CALL CLEAR$LOW$SCREEN;
END;

DO I = 0 TO 2;
  IF ARRAY(I)
  THEN DO;
    CALL CRT$PRINT$STRING(.TITLE$6);
    CALL SEND$CRLF;
    DO CASE I;
      DO;
        CALL GET$TIME$ZONE(.SYSTEM.NUM$ZONE);
        CALL PRINT$TIME$ZONE(.SYSTEM.NUM$ZONE);
      END;
      DO;
        CALL INITIATE$TIME;
      END;
      DO;
        OK = 0;
        DO WHILE OK = 0;
          CALL CRT$PRINT$STRING(.M3);
          CALL SEND$CRLF;
          VALUE = 0;

```


EXECUTIVE#CMDS

INPUT\$TIME

```

DO WHILE (VALUE > 250) OR (VALUE < 15);
  CALL CRT$PRINT$STRING(.M4);
  VALUE = GET$ADDRESS(3);
  IF (VALUE > 250) OR (VALUE < 15)
  THEN DO;
    CALL CRT$PRINT$STRING(.M5);
    CALL SEND$BEL;
    CALL SEND$CR;
    CALL SEND$SUB;
    END;
  ELSE DO;
    CALL CRT$WRITE(17H); /* ERASE TO END OF LINE */
    CALL SEND$CRLF;
    END;
  END;
  OK = CHECK$INPUT;
  CALL CLEAR$LOW$SCREEN;
  END;
END;
/* END CASE */
/* END THEN DO */
/* END DO */
END;
IF ARRAY(2) THEN RETURN LOW(VALUE);
ELSE RETURN 0;
END INPUT$TIME;

END EXECUTIVE#CMDS;

```


CPA\$MODULE

CPA\$MODULE

CPA\$MODULE: DO;
\$NOLIST

\$INCLUDE (:F1:EXTER. SRC)

\$INCLUDE (:F1:EXTER1. SRC)

\$LIST

DCL SAFE\$RNG (4) BYTE EXTERNAL;


```

/*****
*
* CONV$CONTACT$TIME:
* THIS PROCEDURE IS USED TO CONVERT A GIVEN CONTACT TIME (IN HOURS,
* MINUTES, AND SECONDS) INTO A FP REPRESENTATION (IN HOURS AND TENTHS
* OF HOURS).
*
* PARAMETERS:
* - S. - POINTER TO A MEMORY LOCATION IN WHICH THE TIME IS LOCATED
* (IN HOURS, MINUTES, AND SECONDS).
* - T. - POINTER TO A MEMORY LOCATION IN WHICH THE FP VALUE REPRESENT-
* ING THE TIME IS DESIRED TO BE PLACED.
*
*****/
CONV$CONTACT$TIME: PROCEDURE (S, T) PUBLIC;
    DCL (S, T) ADDRESS,
        STRING BASED S (3) BYTE,
        TIME$FLOAT BASED T (4) BYTE,
        TEMP (4) BYTE,
        FP$60 (4) BYTE DATA (00H,00H,70H,42H),
        FP$3600 (4) BYTE DATA (00H,00H,61H,45H);
    TEMP(0) = STRING(0);
    TEMP(1), TEMP(2), TEMP(3) = 00H;
    CALL FLTDS (.TEMP, .TIME$FLOAT);
    TEMP(0) = STRING(1);
    TEMP(1), TEMP(2), TEMP(3) = 00H;
    CALL FLTDS (.TEMP, .TEMP);
    CALL FDIV (.TEMP, .FP$60, .TEMP);
    CALL FADD (.TEMP, .TIME$FLOAT, .TIME$FLOAT);
    TEMP(0) = STRING(2);
    TEMP(1), TEMP(2), TEMP(3) = 00H;

```


CPA\$MODULE

CONV\$CONTACT\$TIME

```
CALL FLTDS (.TEMP, .TEMP);  
CALL FDIY (.TEMP, .FP$3600, .TEMP);  
CALL FADD (.TEMP, .TIME$FLOAT, .TIME$FLOAT);  
END CONV$CONTACT$TIME;
```



```

/*****
*
* CPA$TIME$CONV:
* THIS PROCEDURE IS CALLED BY THE "CPA$CALCULATION" PROCEDURE IN
* ORDER TO CONVERT A FP REPRESENTATION OF THE CPA TIME TO A STRING OF
* ASCII CHARACTERS.
*
* PARAMETERS:
* - T. - POINTER TO A MEMORY LOCATION IN WHICH THE FP REPRESENTATION OF
* THE CPA TIME IS LOCATED.
* - S. - POINTER TO A MEMORY LOCATION IN WHICH THE STRING OF CHARACTERS RE-
* PRESENTING THE CPA TIME IS DESIRED TO BE PLACED.
*
*****/
CPA$TIME$CONV: PROCEDURE (T, S);
  DCL (T, S) ADDRESS,
       FP$60 (4) BYTE DATA (00H,00H,70H,42H), /* 60.0 */
       CPA$TIME BASED T (4) BYTE,
       STRING BASED S (4) BYTE,
       (HOURS, MINUTES, TEMP) (4) BYTE,
       J BYTE;
  CALL FIXED (.CPA$TIME, .HOURS);
  DO J = 0 TO 3;
    TEMP(J) = HOURS(J);
  END;
  DO WHILE HOURS(0) >= 24;
    HOURS(0) = HOURS(0) - 24;
  END;
  STRING(0) = HOURS(0) / 10 + 30H;
  STRING(1) = HOURS(0) MOD 10 + 30H;
  CALL FLTDS (.TEMP, .TEMP);

```



```
CALL FSUB (.CPA#TIME, .TEMP, .MINUTES);
CALL FMUL (.MINUTES, .FP#60, .MINUTES);
CALL FIXED (.MINUTES, .MINUTES);
IF MINUTES(0) >= 60
THEN DO;
    MINUTES(0) = MINUTES(0) - 60;
    HOURS(0) = HOURS(0) + 1;
    IF HOURS(0) >= 24 THEN HOURS(0) = HOURS(0) - 24;
    STRING(0) = HOURS(0) / 10 + 30H;
    STRING(1) = HOURS(0) MOD 10 + 30H;
END;
STRING(2) = MINUTES(0) / 10 + 30H;
STRING(3) = MINUTES(0) MOD 10 + 30H;
END CPA#TIME#CONV;
```



```

/*****
*
* CONTACT$CRS$SPD:
* THIS PROCEDURE IS USED TO CALCULATE THE COURSE AND SPEED OF A CONTACT
* GIVEN ITS LAST KNOWN POSITION AT "CONTACT$POSI" STRUCTURE.
* THIS PROCEDURE IS CALLED BY THE "CPA$CALCULATION" PROCEDURE.
*
* PARAMETERS:
* - A - POINTER TO A MEMORY LOCATION IN WHICH THE RELATIVE COURSE OF A
*   CONTACT IS LOCATED (IN RADIAN).
* - B - POINTER TO A MEMORY LOCATION IN WHICH THE RELATIVE SPEED OF A
*   CONTACT IS LOCATED (IN KNOTS).
* - S - POINTER TO A MEMORY LOCATION IN WHICH THE STRING OF CHARACTERS
*   REPRESENTING THE TRUE COURSE AND SPEED OF A CONTACT IS DESIRED
*   TO BE PLACED.
* - INDEX - IT IS THE VALUE WHICH GIVES THE LAST KNOWN POSITION IN
*   THE "CONTACT$POSI" STRUCTURE OF A CONTACT BEING PROCESSED
*   BY THE "CPA$CALCULATION" PROCEDURE.
*
*****
CONTACT$CRS$SPD: PROCEDURE (A, B, S, INDEX);
  DCL (A, B, S) ADDRESS,
  CRS BASED A (4) BYTE,
  SPD BASED B (4) BYTE,
  STRING BASED S (9) BYTE,
  FP$DEG#TO$RAD (4) BYTE DATA (35H,0FAH,8EH,3CH), /* 0.0174532925 */
  (TEMP, TEMP1) (4) BYTE,
  (SIN#CRS, COS#CRS) (4) BYTE,
  (X1, X2, XM, Y1, Y2, YM) (4) BYTE,
  (INDEX, I, J) BYTE,
  J = OWN$SHIP$INFO.POINTER;

```



```

DO I = 0 TO 3)
  TEMP(I) = OWN$SHIP(J).CRS(I)
  TEMP1(I) = OWN$SHIP(J).SPD(I)
END;

CALL FMUL (TEMP, .FP$DEG$TO$RAD, .TEMP);
CALL COS$SIN (TEMP, .COS$CRS, .SIN$CRS);
CALL FMUL (TEMP1, .SIN$CRS, .X1);
CALL FMUL (TEMP1, .COS$CRS, .Y1);
CALL COS$SIN (CRS, .COS$CRS, .SIN$CRS);
CALL FMUL (SPD, .SIN$CRS, .X2);
CALL FMUL (SPD, .COS$CRS, .Y2);
CALL FADD (X1, .X2, .XM);
CALL FADD (Y1, .Y2, .YM);
CALL FSQR (XM, .TEMP);
CALL FSQR (YM, .TEMP1);
CALL FADD (TEMP, .TEMP, .TEMP);
CALL FSQRT (TEMP, .TEMP); /* TRUE SPEED */
CALL ARCTAN (YM, .XM, .TEMP1);
CALL FDIV (TEMP1, .FP$DEG$TO$RAD, .TEMP1); /* TRUE COURSE IN DEGREES */
DO I = 0 TO 3)
  CONTACT#POS1(INDEX).CRS(I) = TEMP(I);
  CONTACT#POS1(INDEX).SPD(I) = TEMP1(I);
END;

J = INDEX/15;
CONTACT#INFO(J).CRS$FLAG, CONTACT#INFO(J).SPD$FLAG = OFFH;
J = FP$FORMAT (TEMP1, .STRING(0), 3, 1);
J = FP$FORMAT (TEMP, .STRING(4), 2, 1);
END CONTACT$CRS$SPD;

```



```

/*****
*
* CPA$CALCULATION:
* THIS PROCEDURE IS CALLED BY THE "GET$CPA" PROCEDURE IN ORDER TO
* CALCULATE THE CPA OF A GIVEN CONTACT.
* THE "LEAST SQUARE FIT" METHOD IS USED WITH AT MOST 5 POSITIONS OF
* A GIVEN CONTACT.
*****/
*
* PARAMETERS:
* - INDEX1. - IT INDICATES THE FIRST POSITION AT THE "CONTACT$POS1"
* STRUCTURE THAT HAS THE INFORMATION ABOUT THE GIVEN CONTACT.
* - INDEX2. - IT INDICATES THE FIRST POSITION AT THE "CONTACT$POS1"
* STRUCTURE THAT WILL BE USED IN THE "LEAST SQUARE FIT" COMPUTATION.
* - COUNT. - IT GIVES THE COUNTING USED TO DETERMINE THE NUMBER OF CONTACT
* POSITIONS TO BE USED IN THE CALCULATION OF THE CPA.
* - S. - POINTER TO A MEMORY LOCATION IN WHICH THE STRING OF CHARACTERS
* REPRESENTING THE CPA INFORMATION IS DESIRED TO BE PLACED.
*
*****/
CPA$CALCULATION: PROCEDURE (INDEX1, INDEX2, COUNT, S);
    DCL S ADDRESS,
        STRING BASED S (23) BYTE,
        CHECK BYTE DATA (04H),
        CHECK1 BYTE DATA (02H),
        CHECK2 BYTE DATA (05H),
        FP$DEG$TO$RAD (4) BYTE DATA (35H,0FAH,8EH,3CH), /* 0.0174532925 */
        FP$1 (4) BYTE DATA (00H,00H,80H,3FH), /* 1.0 */
        FP$60 (4) BYTE DATA (00H,00H,70H,42H), /* 60.0 */
        PI$OVER2 (4) BYTE DATA (00EH,0FH,0C9H,3FH), /* 1.5707963 */
        PI$FLOAT (4) BYTE DATA (00EH,0FH,49H,40H), /* 3.141593 */
        PI$3$OVER2 (4) BYTE DATA (0E4H,0CEH,96H,40H), /* 4.7123889 */

```



```

MSG0 (*) BYTE DATA
  ('SAME CRS & SPD'),
MSG1 (*) BYTE DATA
  (' COLLISION'),
MSG2 (*) BYTE DATA
  ('MOVING AWAY '),
REL$XY (5) STRUCTURE
  ( X(4) BYTE,
    Y(4) BYTE),
COS$BERG (4) BYTE, SIN$BERG (4) BYTE,
X1 (4) BYTE, Y1 (4) BYTE,
SLOPE (4) BYTE, Y$CUT (4) BYTE,
BIG$Y1 (4) BYTE, BIG$Y2 (4) BYTE,
X$CPA (4) BYTE, Y$CPA (4) BYTE,
CPA$TIME (4) BYTE, CPA$BERG (4) BYTE, CPA$RNG (4) BYTE,
TIME (4) BYTE, TIME1 (4) BYTE,
S0 (4) BYTE, S1 (4) BYTE, S2 (4) BYTE,
T0 (4) BYTE, T1 (4) BYTE,
X$SQUARE (4) BYTE, XY$PROD (4) BYTE,
S1$SQUARE (4) BYTE, ST$PROD (4) BYTE,
NUMERATOR (4) BYTE, DENOMINATOR (4) BYTE,
<REL$CRS, REL$SPD, TEMP$RAD> (4) BYTE,
<INDEX1, INDEX2, COUNT, TEMP, TEMP1, I, J, FLAG, FLAG1, LAST$POINTER> BYTE;

/* LAST$POINTER WILL POINT TO THE LAST POSITION IN CONTACT$POSI */
TEMP = INDEX1 / 15;
LAST$POINTER = 'CONTACT$INFO(TEMP). POINTER;
TEMP = INDEX2;
DO I = 0 TO 3;
  S0(I), S1(I), S2(I), T0(I), T1(I) = 00H;
END;

```



```

/* COMPUTE PARAMETERS FOR LEAST SQUARE FIT */
SQ(0) = COUNT + 1
CALL FLTDS (.S0, .S0)
DO I = 0 TO COUNT
  IF TEMP > INDEX1 + 14 THEN TEMP = INDEX1
  CALL FMUL (.CONTACT$POS1(TEMP), BRG, .FP$DEG$TO$RAD, .TEMP$RAD)
  CALL COS$SIN (.TEMP$RAD, .COS$BRG, .SIN$BRG)
  CALL FMUL (.CONTACT$POS1(TEMP), RRG, .SIN$BRG, .REL$XY(I, X))
  CALL FMUL (.CONTACT$POS1(TEMP), RRG, .COS$BRG, .REL$XY(I, Y))
  CALL FADD (.REL$XY(I, X), .S1, .S1)
  CALL FSQR (.REL$XY(I, X), X$SQUARE)
  CALL FADD (.X$SQUARE, .S2, .S2)
  CALL FADD (.REL$XY(I, Y), .T0, .T0)
  CALL FMUL (.REL$XY(I, Y), .REL$XY(I, X), XY$PROD)
  CALL FADD (.XY$PROD, .T1, .T1)
  TEMP = TEMP + 1
END

CALL FMUL (.S0, .S2, .DENOMINATOR)
CALL FSQR (.S1, .S1$SQUARE)
CALL FSUB (.DENOMINATOR, .S1$SQUARE, .DENOMINATOR)
CALL FMUL (.S0, .T1, .NUMERATOR)
CALL FMUL (.S1, .T0, .S1$PROD)
CALL FSUB (.NUMERATOR, .S1$PROD, .NUMERATOR)
FLAG = FZTST (.DENOMINATOR, .CHECK)
FLAG1 = FZTST (.NUMERATOR, .CHECK)
IF FLAG AND FLAG1 THEN I = 0
IF FLAG AND (NOT FLAG1) THEN I = 1
IF (NOT FLAG) AND FLAG1 THEN I = 2
IF (NOT FLAG) AND (NOT FLAG1) THEN I = 3 /* SLOPE < 0 */
TEMP = LAST$POINTER
IF TEMP = INDEX1
  /* SLOPE = 0/0 */
  /* SLOPE = %/0 */
  /* SLOPE = 0 */
  /* SLOPE < 0 */

```



```

THEN TEMP1 = TEMP + 14;
ELSE TEMP1 = LAST$POINTER - 1;
IF (I = 0) AND (FLAG1 := FCMPC(.CONTACT$POSI(TEMP),RNG,
    .CONTACT$POSI(TEMP1),RNG,.CHECK2))
THEN I = 1;
IF (I = 1) OR (I = 3)
THEN DO;
    IF FCMPC(.CONTACT$POSI(TEMP),BRG,.CONTACT$POSI(TEMP1),BRG,.CHECK) AND
        FCMPC(.CONTACT$POSI(TEMP),RNG,.CONTACT$POSI(TEMP1),RNG,.CHECK)
    THEN I = 0;
    END;
DO CASE I;
DO;
    /* CONTACT ON SAME CRS & SPD OF OWN SHIP */
    TEMP = LAST$POINTER;
    TEMP1 = OWN$SHIP$INFO.POINTER;
    DO J = 0 TO 3;
        CONTACT$POSI(TEMP),CRS(J) = OWN$SHIP(TEMP1),CRS(J);
        CONTACT$POSI(TEMP),SPD(J) = OWN$SHIP(TEMP1),SPD(J);
    END;
    TEMP1 = FP$FORMAT(.CONTACT$POSI(TEMP),CRS,.STRING(0),3,1);
    TEMP1 = FP$FORMAT(.CONTACT$POSI(TEMP),SPD,.STRING(4),2,1);
    TEMP1 = INDEX1 / 15;
    CONTACT$INFO(TEMP1),CRS$FLAG = 0FFH;
    CONTACT$INFO(TEMP1),SPD$FLAG = 0FFH;
    DO J = 7 TO LAST(STRING);
        STRING(J) = MSG0(J - 7);
    END;
END;
DO;
    /* CONTACT RELATIVE COURSE = 000 OR 180 */
    TEMP = LAST$POINTER;
    IF TEMP = INDEX1

```



```

      THEN TEMP1 = TEMP + 14;
      ELSE TEMP1 = LAST$POINTER - 1;
      FLAG = FCMPR(.CONTACT$POSI(TEMP1).RNG..CONTACT$POSI(TEMP).RNG..CHECK1);
      CALL FMUL (.CONTACT$POSI(INDEX2).BRG..FP$DEG$TO$RAD,.TEMP$RAD);
      CALL COS$SIN(.TEMP$RAD)..COS$BRG..SIN$BRG);
      CALL FMUL(.CONTACT$POSI(INDEX2).RNG..SIN$BRG..X$CPA);
      IF X$CPA(3) >= 80H
      THEN X$CPA(3) = X$CPA(3) XOR 080H;
      /* CONVERT TIME TO FP */
      TEMP = LAST$POINTER;
      CALL CONV$CONTACT$TIME(.CONTACT$POSI(INDEX2).TIME..TIME);
      IF CONTACT$POSI(INDEX2).TIME(0) >
      CONTACT$POSI(TEMP).TIME(0)
      THEN DO;
        CONTACT$POSI(TEMP).TIME(0) = CONTACT$POSI(TEMP).TIME(0) + 24;
        CALL CONV$CONTACT$TIME(.CONTACT$POSI(TEMP).TIME..TIME);
        CONTACT$POSI(TEMP).TIME(0) = CONTACT$POSI(TEMP).TIME(0) - 24;
      END;
      ELSE CALL CONV$CONTACT$TIME(.CONTACT$POSI(TEMP).TIME..TIME);
      /* COMPUTE RELATIVE COURSE */
      IF (FLAG1 := FCMPR(.REL$XY(COUNT).Y..REL$XY(0).Y..CHECK1))
      THEN DO;
        DO J = 0 TO 3;
          REL$CR5(J) = 00H;
        END;
      END;
      ELSE DO;
        DO J = 0 TO 3;
          REL$CR5(J) = PI$FLOAT(J);
        END;
      END;

```



```

/* COMPUTE RELATIVE SPEED */
CALL FSUB (.TIME1, .TIME, .TIME1);
CALL FSUB (.REL$XY(COUNT), Y, .REL$XY(6), Y, .Y1);
IF Y1(3) >= 80H THEN Y1(3) = Y1(3) XOR 80H;
CALL FDIY (.Y1, .TIME1, .REL$SPD);
/* COMPUTE TRUE COURSE AND SPEED */
TEMP = LAST$POINTER;
CALL CONTACT$CRS$SPD (.REL$CRS, .REL$SPD, .STRING, TEMP);
IF FLAG
THEN DO;
    /* CONTACT CLOSING */
    /* COMPUTE CPA TIME */
    CALL FMUL (.CONTACT$POSI(INDEX2), RNG, .COS$BRG, Y$CPA);
    CALL FDIY (.Y$CPA, .REL$SPD, .CPA$TIME);
    IF CPA$TIME(3) >= 080H
    THEN CPA$TIME(3) = CPA$TIME(3) XOR 080H;
    CALL FADD(.CPA$TIME, .TIME, .CPA$TIME);
    CALL CPA$TIME$CONV (.CPA$TIME, .STRING(7));
    /* CHECK FOR COLLISION */
    IF (FLAG1 := FCMPR (.SAFE$RNG, X$CPA, .CHECK1))
    THEN DO;
        DO J = 11 TO LAST(STRING);
            STRING(J) = MSG1(J - 11);
        END;
        RETURN;
    END;
    /* COMPUTE CPA BEARING */
    CALL FMUL (.CONTACT$POSI(INDEX2), BRG, .FP$DEG$TO$RAD, .TEMP$RAD);
    IF (FLAG1 := FCMPR(.PI$FLOAT, .TEMP$RAD, .CHECK1))
    THEN DO;
        STRING(11) = '0';
        STRING(12) = '9';
    END;

```



```

        STRING(13) = '0'
        STRING(14) = '0'
        END;
    ELSE DO;
        STRING(11) = '2';
        STRING(12) = '7';
        STRING(13) = '0';
        STRING(14) = '0';
        END;
    /* COMPUTE CPA RANGE */
    CALL RANGE$FORMAT (.X$CPA, .STRING(15));
    END;
ELSE DO; /* CONTACT MOVING AWAY */
    DO J = 7 TO LAST(STRING);
        STRING(J) = MSG2(J - 7);
    END;
    END;

END;
DO; /* CONTACT RELATIVE COURSE = 090 OR 270 */
    TEMP = LAST$POINTER;
    IF TEMP = INDEX1
    THEN TEMP1 = TEMP + 14;
    ELSE TEMP1 = LAST$POINTER - 1;
    FLAG = FCMPR(.CONTACT$POSI(TEMP1).RNG, .CONTACT$POSI(TEMP).RNG,
        .CHECK1);
    CALL FMUL (.CONTACT$POSI(INDEX2).BRG, .FP$DEG$TO$RAD, .TEMP$RAD);
    CALL COS$SIN(.TEMP$RAD, .COS$BRG, .SIN$BRG);
    CALL FMUL(.CONTACT$POSI(INDEX2).RNG, .COS$BRG, .Y$CPA);
    IF Y$CPA(3) >= 080H
    THEN Y$CPA(3) = Y$CPA(3) XOR 080H;
    /* CONVERT TIME TO FP */

```



```

TEMP = LAST$POINTER;
CALL CONV$CONTACT$TIME(. CONTACT$POSI(INDEX2), TIME, TIME);
IF CONTACT$POSI(INDEX2), TIME(0) >
    CONTACT$POSI(TEMP), TIME(0)
THEN DO;
    CONTACT$POSI(TEMP), TIME(0) = CONTACT$POSI(TEMP), TIME(0) + 24;
    CALL CONV$CONTACT$TIME(. CONTACT$POSI(TEMP), TIME, TIME);
    CONTACT$POSI(TEMP), TIME(0) = CONTACT$POSI(TEMP), TIME(0) - 24;
END;
ELSE CALL CONV$CONTACT$TIME(. CONTACT$POSI(TEMP), TIME, TIME);
/* COMPUTE RELATIVE COURSE */
IF(FLAG1:= FCMPR (. REL$XY(COUNT), % , REL$XY(0), % , CHECK1))
THEN DO;
    DO J = 0 TO 3;
        REL$CRS(J) = PI$OVER2(J);
    END;
END;
ELSE DO;
    DO J = 0 TO 3;
        REL$CRS(J) = PI$3$OVER2(J);
    END;
END;
/* COMPUTE RELATIVE SPEED */
CALL FSUB (. TIME1, . TIME, . TIME1);
CALL FSUB (. REL$XY(COUNT), % , REL$XY(0), % , X1);
IF X1(3) >= 80H THEN X1(3) = X1(3) XOR 80H;
CALL FDIV(. X1, . TIME1, . REL$SPD);
/* COMPUTE TRUE COURSE AND SPEED */
TEMP = LAST$POINTER;
CALL CONTACT$CRS$SPD (. REL$CRS, . REL$SPD, . STRING, TEMP);
IF FLAG

```



```

THEN DO;
    /* CONTACT CLOSING */
    /* COMPUTE CPA TIME */
    CALL FMUL(.CONTACT$POS1(INDEX2).BRG, .SIN$BRG, .X$CPA);
    CALL FDIV(.X$CPA, .REL$SPD, .CPA$TIME);
    IF CPA$TIME(3) >= 080H
    THEN CPA$TIME(3) = CPA$TIME(3) XOR 080H;
    CALL FADD(.CPA$TIME, .TIME, .CPA$TIME);
    CALL CPA$TIME$CONV(.CPA$TIME, .STRING(7));
    /* CHECK FOR COLLISION */
    IF (FLAG1 := FCMPR(.SAFE$BRG, .Y$CPA, .CHECK1))
    THEN DO;
        DO J = 11 TO LAST(STRING);
            STRING(J) = MSG1(J - 11);
        END;
        RETURN;
    END;
    /* COMPUTE CPA BEARING */
    CALL FMUL(.CONTACT$POS1(INDEX2).BRG, .FP$DEG$TO$RAD, .TEMP$RAD);
    IF (FLAG := FCMPR(.PI$3$OVER2, .TEMP$RAD, .CHECK1))
    AND (FLAG := FCMPR(.TEMP$RAD, .PI$OVER2, .CHECK1))
    THEN DO;
        STRING(11) = '1';
        STRING(12) = '8';
        STRING(13) = '0';
        STRING(14) = '0';
    END;
ELSE DO;
    STRING(11) = '0';
    STRING(12) = '0';
    STRING(13) = '0';
    STRING(14) = '0';

```



```

END;
/* COMPUTE CPA RANGE */
CALL RANGE$FORMAT (.Y$CPA, .STRING(15));
END;
ELSE DO; /* CONTACT MOVING AWAY */
DO J = 7 TO LAST(STRING);
STRING(J) = MSG2(J - 7);
END;
END;

/* RELATIVE MOVE - GENERAL CASE */
DO;
TEMP = LAST$POINTER;
IF TEMP = INDEX1
THEN TEMP1 = TEMP + 14;
ELSE TEMP1 = LAST$POINTER - 1;
FLAG = FCMPR(.CONTACT$POSI(TEMP1).RNG,.CONTACT$POSI(TEMP).RNG,
              .CHECK1);
/* PERFORM LEAST SQUARE FIT FOR LAST POSITIONS */
CALL FOIV (.NUMERATOR, .DENOMINATOR, .SLOPE);
/* COMPUTE SLOPE */
/* COMPUTE CUT AT Y AXIS */
CALL FMUL (.S2, .T0, .NUMERATOR);
CALL FMUL (.S1, .T1, .ST$PROD);
CALL FSUB (.NUMERATOR, .ST$PROD, .NUMERATOR);
CALL FOIV (.NUMERATOR, .DENOMINATOR, .Y$CUT);
/* COMPUTE RELATIVE COURSE */
/* PREPARE TO COMPUTE RELATIVE SPEED */
CALL FMUL(.SLOPE, .REL$XY(0).X, .BIG$Y1);
CALL FADD(.BIG$Y1, .Y$CUT, .BIG$Y1);
CALL FMUL(.SLOPE, .REL$XY(COUNT).X, .BIG$Y2);
CALL FADD(.BIG$Y2, .Y$CUT, .BIG$Y2);

```



```

CALL FSUB(.BIG$Y2, .BIG$Y1, .NUMERATOR);
CALL FSUB(.REL$XY(COUNT).X, .REL$XY(0).X, .DENOMINATOR);
CALL ARC$TAN(.NUMERATOR, .DENOMINATOR, .REL$CRS);
CALL FSQR(.NUMERATOR, .NUMERATOR);
CALL FSQR(.DENOMINATOR, .DENOMINATOR);
CALL FADD(.NUMERATOR, .DENOMINATOR, .NUMERATOR);
CALL FSQRT(.NUMERATOR, .NUMERATOR);
      /* CONVERT TIME TO FP */
TEMP = LAST$POINT;
CALL CONV$CONTACT$TIME(.CONTACT$POSI(INDEX2).TIME, .TIME);
IF CONTACT$POSI(INDEX2).TIME(0) >
CONTACT$POSI(TEMP).TIME(0)
THEN DO;
    CONTACT$POSI(TEMP).TIME(0) = CONTACT$POSI(TEMP).TIME(0) + 24;
    CALL CONV$CONTACT$TIME(.CONTACT$POSI(TEMP).TIME, .TIME);
    CONTACT$POSI(TEMP).TIME(0) = CONTACT$POSI(TEMP).TIME(0) - 24;
END;
ELSE DO;
    CALL CONV$CONTACT$TIME(.CONTACT$POSI(TEMP).TIME, .TIME);
END;

CALL FSUB(.TIME1, .TIME, .TIME1);
      /* COMPUTE RELATIVE SPEED */
CALL FDIV(.NUMERATOR, .TIME1, .REL$SPD);
      /* COMPUTE TRUE COURSE AND SPEED */
TEMP = LAST$POINT;
CALL CONTACT$CRS$SPD (.REL$CRS, .REL$SPD, .STRING, TEMP);
IF FLAG,
THEN DO;
      /* CONTACT CLOSING */
      /* COMPUTE CPA */
CALL FMUL(.SLOPE, .REL$XY(0).X, .NUMERATOR);
CALL FSUB(.NUMERATOR, .BIG$Y1, .NUMERATOR);

```



```

CALL FMUL(.SLOPE, .NUMERATOR, .NUMERATOR);
CALL FSQR(.SLOPE, .DENOMINATOR);
CALL FADD(.DENOMINATOR, .FP$1, .DENOMINATOR);
/* COMPUTE X$CPA */
CALL FDIV(.NUMERATOR, .DENOMINATOR, .X$CPA);
/* COMPUTE Y$CPA */
CALL FMUL(.SLOPE, .REL$XY(0), .X, .NUMERATOR);
CALL FSUB(.BIG$Y1, .NUMERATOR, .NUMERATOR);
CALL FDIV(.NUMERATOR, .DENOMINATOR, .Y$CPA);
/* COMPUTE CPA TIME */
CALL FSUB(.X$CPA, .REL$XY(0), .X, .NUMERATOR);
CALL FSQR(.NUMERATOR, .NUMERATOR);
CALL FSUB(.Y$CPA, .BIG$Y1, .DENOMINATOR);
CALL FSQR(.DENOMINATOR, .DENOMINATOR);
CALL FADD(.NUMERATOR, .DENOMINATOR, .NUMERATOR);
CALL FSQR(.NUMERATOR, .NUMERATOR);
CALL FDIV(.NUMERATOR, .REL$SPD, .CPA$TIME);
CALL FADD(.TIME, .CPA$TIME, .CPA$TIME);
CALL CPA$TIME$CONV (.CPA$TIME, .STRING(7));
/* COMPUTE CPA RANGE */
CALL FSQR(.X$CPA, .NUMERATOR);
CALL FSQR(.Y$CPA, .DENOMINATOR);
CALL FADD(.NUMERATOR, .DENOMINATOR, .NUMERATOR);
CALL FSQR(.NUMERATOR, .CPA$RNG);
/* CHECK FOR COLLISION */
IF (FLAG1 := FCMPR (.SAFE$RNG, .CPA$RNG, .CHECK1))
  THEN DO;
  DO J = 11 TO LAST(STRING);
    STRING(J) = MSG1(J - 11);
  END;
  RETURN;

```



```

END;
/* COMPUTE CPA BEARING */
CALL ARC$TAN(.Y$CPA, .X$CPA, .CPA$BERG);
CALL CONV$RAD$MIN(.CPA$BERG, .CPA$BERG);
CALL FDIY(.CPA$BERG, .FP$60, .CPA$BERG);
TEMP = FP$FORMAT (.CPA$BERG, .STRING(11), 3, 1);
CALL RANGE$FORMAT(.CPA$BERG, .STRING(15));
END;
ELSE DO;
/* CONTACT MOVING AWAY */
DO J = 7 TO LAST(STRING);
STRING(J) = MSG2(J - 7);
END;
END;
END;

END; /* END CASE */
END CPA$CALCULATION;

```



```

/*****
*
* GET$CPA:
* THIS PROCEDURE IS USED TO FIND THE CPA INFORMATION ABOUT A CONTACT.
*
* PARAMETERS:
* - INDEX - INDICATES THE RELATIVE POSITION OF THE CONTACT IN THE
* CONTACT$INFO STRUCTURE.
* - A - POINTER TO A MEMORY LOCATION IN WHICH THE STRING OF CHARACTERS
* REPRESENTING THE CPA INFORMATION IS DESIRED TO BE PLACED.
*
* USAGE:
* TYPED PROCEDURE. RETURNS A VALUE OF 0 IF NO CPA CAN BE DETERMINED AT
* THE MOMENT. OTHERWISE, A VALUE OF 1 IS RETURNED.
*
*****/
GET$CPA: PROCEDURE (INDEX, A) BYTE PUBLIC;
  DCL A ADDRESS,
        STRING BASED A (23) BYTE,
        (INDEX, INDEX1, COUNT, TEMP, P1, P2, I) BYTE;
  DO I = 0 TO LAST(STRING);
    STRING(I) = 020H; /* PUT BLANKS IN WORK BUFFER */
  END;
  INDEX1 = 15*INDEX;
  IF (CONTACT$INFO(INDEX).POINTER < INDEX1 + 1) AND
    (NOT CONTACT$INFO(INDEX).FLAG)
  THEN RETURN 0;
  P1 = CONTACT$INFO(INDEX).POINTER;
  P2 = CONTACT$INFO(INDEX).OS$POINTER;
  IF CONTACT$INFO(INDEX).FLAG
  THEN DO;

```



```
IF P2 = 0FFH
THEN DO;
  COUNT = 4;
  IF P1 < INDEX1 + 4
  THEN TEMP = P1 + 11;
  ELSE TEMP = P1 - 4;
END;
ELSE DO;
  COUNT = 0;
  TEMP = P2 + 1;
  IF TEMP = (INDEX1 + 15)
  THEN TEMP = INDEX1;
  DO WHILE TEMP <> P1;
    IF TEMP = (INDEX1 + 15)
    THEN TEMP = INDEX1;
    ELSE TEMP = TEMP + 1;
    COUNT = COUNT + 1;
  END;
  IF COUNT = 0
  THEN RETURN 0;
  TEMP = P2 + 1;
  IF TEMP = (INDEX1 + 15)
  THEN TEMP = INDEX1;
END;
ELSE DO;
  IF P2 = 0FFH
  THEN DO;
    COUNT = P1 - INDEX1;
    IF COUNT > 4 THEN COUNT = 4;
    TEMP = P1 - COUNT;
```


CPA\$MODULE

GET\$CPA

```
END;
ELSE DO;
  IF P1 = P2 THEN RETURN 0;
  COUNT = P1 - P2 - 1;
  TEMP = P2 + 1;
  IF COUNT = 0 THEN RETURN 0;
END;
END;
CALL CPA$CALCULATION<INDEX1, TEMP, COUNT, .STRING>;
RETURN 1;
END GET$CPA;
```

END CPA\$MODULE;

DISPLAY\$CMDS

DISPLAY\$CMDS

DISPLAY\$CMDS: DO;

\$NOLIST

\$INCLUDE (:F1:EXTER.SRC)

\$INCLUDE (:F1:EXTER1.SRC)

\$LIST

GET\$CPA:

PROCEDURE (A,B) BYTE EXTERNAL;
DCL A BYTE, B ADDRESS; END;

CONV\$CONTACT\$TIME:

PROCEDURE (A, B) EXTERNAL;
DCL (A, B) ADDRESS; END;

DCL SAFE\$RNG (4) BYTE EXTERNAL;

DCL

TITLE#0 (*) BYTE DATA

('

TITLE#1 (*) BYTE DATA

('

TITLE#2 (*) BYTE DATA

('

TITLE#3 (*) BYTE DATA

COORDINATE GRID ORIGIN##'),

GRAPHICS SCALE##'),

OWN SHIP INFORMATION##'),

DISPLAY\$CMDS

DISPLAY\$CMDS

```

(
  TITLE$4 (*) BYTE DATA
  (
  TITLE$5 (*) BYTE DATA
  (
  TITLE$6 (*) BYTE DATA
  (
  TITLE$7 (*) BYTE DATA
  (
    CONTACT INFORMATION$$'),
    SYSTEM INFORMATION. $$'),
    CURRENT SAFE C. P. A. RANGE $$'),
    WIND INFORMATION$$'),
    CURRENT TIME BETWEEN UPDATES. $$');

```

```

DCL
MSG#00 (*) BYTE DATA ('POSITIONAL DATA:$$'),
MSG#01 (*) BYTE DATA ('TACTICAL DATA AT $$'),
MSG#02 (*) BYTE DATA ('C. P. A. DATA:$$'),
MSG#03 (*) BYTE DATA ('GENERAL DATA:$$');

```

```

DCL
PLUS$SIGN LIT '02BH',
MINUS$SIGN LIT '02DH',
COLON LIT '03AH',
POINT LIT '02EH',
BLANK LIT '020H';

```



```

/*****
*
* CONV$LAT$LONG:
* THIS PROCEDURE IS USED TO CONVERT GIVEN 'X,Y' COORDINATES, INTO LATITUDE
* AND LONGITUDE VALUES.
*
* PARAMETERS:
* - A. - POINTER TO A MEMORY LOCATION IN WHICH THE FP REPRESENTATION OF 'X'
* IS LOCATED.
* - B. - POINTER TO A MEMORY LOCATION IN WHICH THE FP REPRESENTATION OF 'Y'
* IS LOCATED.
* - C. - POINTER TO A MEMORY LOCATION IN WHICH THE VALUE OF THE LATITUDE, IN
* MINUTES, IS DESIRED TO BE PLACED.
* - D. - POINTER TO A MEMORY LOCATION IN WHICH THE VALUE OF THE LONGITUDE, IN
* MINUTES, IS DESIRED TO BE PLACED.
*
*****/
CONV$LAT$LONG: PROCEDURE (A,B,C,D) PUBLIC
. DCL (A,B,C,D) ADDRESS,
. X BASED A (4) BYTE,
. Y BASED B (4) BYTE,
. LAT BASED C (4) BYTE,
. LONG BASED D (4) BYTE,
. MEAN$LAT (4) BYTE,
. COS$MEAN$LAT (4) BYTE,
. SIN$MEAN$LAT (4) BYTE,
. FP#2 (4) BYTE DATA (00H, 00H, 00H, 40H);
. CALL FADD(X,Y,SYSTEM,LAT, .LAT);
. CALL FADD(C,SYSTEM,LAT, .LAT, .MEAN$LAT);
. CALL FDIV(C,MEAN$LAT, .FP#2, .MEAN$LAT);
. CALL CONV$MIN$RAD(C,MEAN$LAT, .MEAN$LAT);

```


DISPLAY#CMDS

CONV#LAT#LONG

```
CALL COS#SIN(. MEAN#LAT, . COS#MEAN#LAT, . SIN#MEAN#LAT);  
CALL FDIV(. X, . COS#MEAN#LAT, . LONG);  
CALL FADD(. LONG, . SYSTEM. LONG, . LONG);  
END CONV#LAT#LONG;
```



```

/*****
*
* DISPLAY$DESIG:
* THIS PROCEDURE IS USED TO DISPLAY THE DESIG CHARACTERS.
*
* PARAMETERS:
* - DESIG - ADDRESS VALUE REPRESENTING THE 'HASHED' VALUE OF THE DESIGNATION
* DESIRED TO BE DISPLAYED.
*
*****/
DISPLAY$DESIG: PROCEDURE(DESIG) PUBLIC;
    DCL DESIG ADDRESS,
        CHAR(4) BYTE;
    DCL D (10) BYTE DATA ('DESIG: $$');
    CALL CRT$PRINT$STRING(D);
    CALL DE$HASH(DESIG, CHAR);
    CHAR(2), CHAR(3) = '$';
    CALL CRT$PRINT$STRING(CHAR);
    END DISPLAY$DESIG;

```



```

/*****
*
* DISPLAY$TYPE:
*   THIS PROCEDURE IS USED TO DISPLAY THE TYPE OF A CONTACT.
*
* PARAMETERS:
*   - A - POINTER TO A BYTE VALUE REPRESENTING THE TYPE TO BE DISPLAYED.
*
*****/
DISPLAY$TYPE: PROCEDURE (A) PUBLIC;
  DCL A ADDRESS,
        TYPE BASED A BYTE;
  DCL S (*) BYTE DATA ('SURFACE   $$'),
        SS (*) BYTE DATA ('SUB-SURFACE$$'),
        T (10) BYTE DATA ('TYPE:   $$');

  CALL CRT$PRINT$STRING(.T);
  IF TYPE = 0
  THEN CALL CRT$PRINT$STRING(.S);
  ELSE CALL CRT$PRINT$STRING(.SS);
  END DISPLAY$TYPE;

```



```

/*****
*
* DISPLAY$CLASS:
* THIS PROCEDURE IS USED TO DISPLAY THE CLASS OF A CONTACT.
*
* PARAMETERS:
* - A - POINTER TO A MEMORY LOCATION IN WHICH THE CLASS TO BE DISPLAYED IS
*   LOCATED.
*
*****/
DISPLAY$CLASS: PROCEDURE (A) PUBLIC
  DCL A ADDRESS,
        CLASS BASED A BYTE,
  DCL FRI (*) BYTE DATA (' FRIEND$'),
  HOS (*) BYTE DATA (' HOSTILE$'),
  UNK (*) BYTE DATA (' UNKNOWN$'),
  C (10) BYTE DATA (' CLASS: $'),

  CALL CRT$PRINT$STRING(C),
  DO CASE CLASS,
    CALL CRT$PRINT$STRING(C, FRI),
    CALL CRT$PRINT$STRING(C, HOS),
    CALL CRT$PRINT$STRING(C, UNK),
  END,
  END DISPLAY$CLASS;

```



```

/*****
*
* DISPLAY$LAT$LONG:
* THIS PROCEDURE IS USED TO DISPLAY THE VALUES OF LATITUDE AND LONGITUDE.
*
* PARAMETERS:
* - KIND. - DENOTES LATITUDE IF 0, OTHERWISE DENOTES LONGITUDE.
* - A. - POINTER TO THE FP REPRESENTATION OF LAT/LONG.
*
*****/
DISPLAY$LAT$LONG: PROCEDURE (KIND, A) PUBLIC;
  DCL A ADDRESS,
        VALUE BASED A (4) BYTE,
        CHAR (9) BYTE,
        (KIND, 1) BYTE;
  DCL LAT (14) BYTE DATA ('LATITUDE:  $'),
        LONG (14) BYTE DATA ('LONGITUDE:  $'),
        NORTH (8) BYTE DATA ('NORTH$'),
        SOUTH (8) BYTE DATA ('SOUTH$'),
        EAST (8) BYTE DATA ('EAST $'),
        WEST (8) BYTE DATA ('WEST $');

  IF KIND = 0
  THEN DO;
    CALL CRT$PRINT$STRING(LAT);
    CALL LAT$LONG$FORMAT(A, .CHAR, 0);
  END;
ELSE DO;
  CALL CRT$PRINT$STRING(LONG);
  CALL LAT$LONG$FORMAT(A, .CHAR, 1);
END;

```


DISPLAY\$CMDS

DISPLAY\$LAT\$LONG

```
DO I = 0 TO 5;
  IF I = 3 THEN CALL CRT$WRITE(COLON);
  IF I = 5 THEN CALL CRT$WRITE(POINT);
  CALL CRT$WRITE(CHAR(I));
END;
IF KIND = 0
THEN DO;
  IF CHAR(6) = 'N'
  THEN CALL CRT$PRINT$STRING(. NORTH);
  ELSE CALL CRT$PRINT$STRING(. SOUTH);
END;
ELSE DO;
  IF CHAR(6) = 'E'
  THEN CALL CRT$PRINT$STRING(. EAST);
  ELSE CALL CRT$PRINT$STRING(. WEST);
END;
END DISPLAY$LAT$LONG;
```



```

/*****
*
* DISPLAY$XY:
* THIS PROCEDURE IS USED TO DISPLAY VALUES OF 'X,Y' COORDINATES.
*
* PARAMETERS:
* - TYPE - IF 0 'X' WILL BE DISPLAYED, OTHERWISE 'Y' WILL BE DISPLAYED.
* - A - POINTER TO A FP REPRESENTATION OF THE X/Y VALUE.
*
*****/
DISPLAY$XY: PROCEDURE (TYPE, A) PUBLIC;
  DCL A ADDRESS,
        CHAR (14) BYTE,
        (TYPE, TEMP, I) BYTE;
  DCL X (8) BYTE DATA ('X', $$'),
        Y (8) BYTE DATA ('Y', $$');
  IF TYPE = 0
  THEN CALL CRT$PRINT$STRING(, X);
  ELSE CALL CRT$PRINT$STRING(, Y);
  TEMP = FP$FORMAT(A, , CHAR, 10, 2);
  IF TEMP = 0
  THEN CALL CRT$WRITE(PLUS$SIGN);
  ELSE CALL CRT$WRITE(MINUS$SIGN);
  DO I = 0 TO 11;
    IF I = 10 THEN CALL CRT$WRITE(POINT);
    CALL CRT$WRITE(CHAR(I));
  END;
END DISPLAY$XY;

```



```

/*****
*
* DISPLAY$CRS$BRG:
* THIS PROCEDURE IS USED TO DISPLAY THE VALUES OF COURSE AND BEARING.
*
* PARAMETERS:
* - KIND. - IF 0 THE VALUE OF COURSE WILL BE DISPLAYED, OTHERWISE THE VALUE
* OF BEARING WILL BE DISPLAYED.
* - A. - POINTER TO THE FP REPRESENTATION OF COURSE/BEARING.
*
*****/
DISPLAY$CRS$BRG: PROCEDURE (KIND, A) PUBLIC;
  DCL A ADDRESS,
        CHAR (6) BYTE,
        (1, TEMP, KIND) BYTE;
  DCL CRS (12) BYTE DATA ('COURSE:  $$'),
        BRG (12) BYTE DATA ('BEARING:  $$');

  IF KIND = 0
    THEN CALL CRT$PRINT$STRING(C, CRS);
  ELSE CALL CRT$PRINT$STRING(C, BRG);
  TEMP = FP$FORMAT(A, .CHAR, 3, 1);
  DO I = 0 TO 3;
    IF I = 3 THEN CALL CRT$WRITE(POINT);
    CALL CRT$WRITE(CHAR(I));
  END;
  END DISPLAY$CRS$BRG;

```


DISPLAY\$CMDS

DISPLAY\$SPD

```

/*****
*
* DISPLAY$SPD:
*   THIS PROCEDURE IS USED TO DISPLAY THE VALUE OF SPEED.
*
* PARAMETERS:
*   - A - POINTER TO THE FP REPRESENTATION OF THE VALUE OF SPEED.
*
*****/
DISPLAY$SPD: PROCEDURE (A) PUBLIC;
  DCL A ADDRESS,
        CHAR (5) BYTE,
        (TEMP, I) BYTE;

  DCL SPD (12) BYTE DATA ('SPEED:  ');

  CALL CRT$PRINT$STRING(.SPD);
  TEMP = FP$FORMAT(A, CHAR, 2, 1);
  DO I = 0 TO 2;
    IF I = 2 THEN CALL CRT$WRITE(POINT);
    CALL CRT$WRITE(CHAR(I));
  END;
END DISPLAY$SPD;

```



```

/*****
*
* DISPLAY$RANGE:
*   THIS PROCEDURE IS USED TO DISPLAY THE VALUE OF RANGE.
*
* PARAMETERS:
*   - A - POINTER TO THE FP REPRESENTATION OF RANGE.
*
*****/
DISPLAY$RANGE: PROCEDURE (A) PUBLIC;
  DCL A ADDRESS,
       CHAR (8) BYTE,
       I BYTE;
  DCL MLS (8) BYTE DATA (' MILES$$'),
       YDS (8) BYTE DATA (' YARDS$$'),
       RNG (12) BYTE DATA ('RANGE:  $$');

  CALL CRT$PRINT$STRING(.RNG);
  CALL RANGE$FORMAT(A, .CHAR);
  DO I = 0 TO 4;
    CALL CRT$WRITE(CHAR(I));
  END;
  IF CHAR(5) = 'M'
    THEN CALL CRT$PRINT$STRING(.MLS);
  ELSE CALL CRT$PRINT$STRING(.YDS);
  END DISPLAY$RANGE;

```



```

/*****
*
* DISPLAY$TIME:
* THIS PROCEDURE IS USED TO DISPLAY THE VALUE OF THE TIME.
*
* PARAMETERS:
* - A - POINTER TO A 3 BYTE VECTOR CONTAINING THE TIME VALUE.
*
*****/
DISPLAY$TIME: PROCEDURE (A) PUBLIC;
    DCL A ADDRESS,
        DIGIT BASED A BYTE,
        CHAR BYTE;

    DCL TIME (12) BYTE DATA ('TIME:  $$');

    CALL CRT$PRINT$STRING(, TIME);
    CHAR = DIGIT/10 + 30H;
    CALL CRT$WRITE(CHAR);
    CHAR = DIGIT MOD 10 + 30H;
    CALL CRT$WRITE(CHAR);
    A = A + 1;
    CALL CRT$WRITE(COLON);
    CHAR = DIGIT/10 + 30H;
    CALL CRT$WRITE(CHAR);
    CHAR = DIGIT MOD 10 + 30H;
    CALL CRT$WRITE(CHAR);
    A = A + 1;
    CALL CRT$WRITE(COLON);
    CHAR = DIGIT/10 + 30H;
    CALL CRT$WRITE(CHAR);
    CHAR = DIGIT MOD 10 + 30H;

```


DISPLAY#CMDS

DISPLAY#TIME

CALL CRT#WRITE(CHAR);
END DISPLAY#TIME;


```

/*****
*
* DISPLAY$ORIGIN:
* THIS PROCEDURE IS USED TO DISPLAY INFORMATION ABOUT THE COORDINATE GRID
* ORIGIN.
*
*****/
DISPLAY$ORIGIN: PROCEDURE PUBLIC;
    DCL MSG (*) BYTE DATA
        ('THE COORDINATE GRID ORIGIN VALUES ARE:$$');

    CALL CRT$PRINT$STRING(, TITLE$0);
    CALL SEND$CRLF;
    CALL CRT$PRINT$STRING(, MSG);
    CALL SEND$CRLF;
    CALL DISPLAY$LAT$LONG(0, , SYSTEM.LAT);
    CALL SEND$CRLF;
    CALL DISPLAY$LAT$LONG(1, , SYSTEM.LONG);
    CALL SEND$CRLF;
    CALL SEND$CRLF;
    CALL CHECK$GO$KEY;
    CALL CLEAR$LOW$SCREEN;
    END DISPLAY$ORIGIN;

```



```

/*****
*
* DISPLAY$SCALE:
* THIS PROCEDURE IS USED TO DISPLAY INFORMATION ABOUT THE SCALE BEING USED
* IN THE GRAPHICS DISPLAY.
*
*****/
DISPLAY$SCALE: PROCEDURE PUBLIC;
    DCL CHAR (6) BYTE,
        (I, TEMP) BYTE;
    DCL MSG (*) BYTE DATA
        ('THE VALUE OF THE GRAPHICS SCALE IS:  $$$');

    CALL CRT$PRINT$STRING(, TITLE$1);
    CALL SEND$CRLF;
    CALL SEND$CRLF;
    CALL CRT$PRINT$STRING(, MSG);
    TEMP = FP$FORMAT(, SYSTEM$SCALE, , CHAR, 2, 2);
    DO I = 0 TO 3;
        IF I = 2 THEN CALL CRT$WRITE(POINT);
        CALL CRT$WRITE(CHAR(I));
    END;
    CALL SEND$CRLF;
    CALL SEND$CRLF;
    CALL CHECK$GO$KEY;
    CALL CLEAR$LOW$SCREEN;
    END DISPLAY$SCALE;

```


/******

* DISPLAY\$OWN\$SHIP:

* THIS PROCEDURE IS USED TO DISPLAY INFORMATION ABOUT THE OWN SHIP.

*

DISPLAY\$OWN\$SHIP: PROCEDURE PUBLIC;

DECL POINTER BYTE;

CALL CRT\$PRINT\$STRING(, TITLE\$2);

CALL SEND\$CRLF;

CALL CRT\$PRINT\$STRING(, MSG\$00);

CALL SEND\$CRLF;

CALL DISPLAY\$LAT\$LONG(0, , OWN\$SHIP\$INFO.LAT);

CALL SEND\$SPACE(12);

CALL DISPLAY\$LAT\$LONG(1, , OWN\$SHIP\$INFO.LONG);

CALL SEND\$CRLF;

POINTER = OWN\$SHIP\$INFO.POINTER;

CALL DISPLAY\$XY(0, , OWN\$SHIP(POINTER).X);

CALL SEND\$SPACE(18);

CALL DISPLAY\$XY(1, , OWN\$SHIP(POINTER).Y);

CALL SEND\$CRLF;

CALL SEND\$CRLF;

CALL CHECK\$GO\$KEY;

CALL CLEAR\$LOW\$SCREEN;

CALL CRT\$PRINT\$STRING(, TITLE\$2);

CALL SEND\$CRLF;

CALL CRT\$PRINT\$STRING(, MSG\$01);

CALL DISPLAY\$TIME(, OWN\$SHIP(POINTER).TIME);

CALL SEND\$CRLF;

CALL DISPLAY\$CRS\$BRG(0, , OWN\$SHIP(POINTER).CRS);

CALL SEND\$SPACE(20);


```
CALL DISPLAY$SPD(<. OWN$SHIP<(POINTER). SPD>);  
CALL SEND$CRLF;  
CALL SEND$CRLF;  
CALL CHECK$GO$KEY;  
CALL CLEAR$LOW$SCREEN;  
END DISPLAY$OWN$SHIP;
```



```

/*****
*
* DISPLAY$CONTACT$INFO:
* THIS PROCEDURE IS USED TO DISPLAY INFORMATION ABOUT ANY CONTACT BEING
* HANDLED BY THE SYSTEM.
*
*****/
DISPLAY$CONTACT$INFO: PROCEDURE PUBLIC;
DCL DESIG ADDRESS,
LAT (4) BYTE,
LONG (4) BYTE,
TIME#1 (4) BYTE, TIME#2 (4) BYTE,
X$DELTA (4) BYTE, Y$DELTA (4) BYTE,
COS$DIST (4) BYTE, SIN$DIST (4) BYTE,
BRG (4) BYTE, RNG (4) BYTE,
T (3) BYTE, DISTANCE (4) BYTE,
STRING (23) BYTE,
(TEMP, OK, INDEX, I, POINTER) BYTE;
DCL DEG$TO$RAD (4) BYTE DATA (035H, 0FAH, 08EH, 03CH); /* 0.0174532925 */

DCL MSG0 (*) BYTE DATA
( 'NO COURSE INFORMATION AVAILABLE. $$' ),
MSG1 (*) BYTE DATA
( 'NO SPEED INFORMATION AVAILABLE. $$' ),
MSG2 (*) BYTE DATA
( 'NO CPA INFORMATION AVAILABLE. $$' ),
MSG3 (*) BYTE DATA
( 'ENTER CONTACT DESIG AS REQUESTED: $$' ),
MSG4 (*) BYTE DATA
( 'DESIG NOT IN USE. $$' ),
MSG5 (*) BYTE DATA

```



```

      ('CURRENT NUMBER OF POSITIONS:  $$'),
MSG6 (*) BYTE DATA
      ('THE ACTUAL ESTIMATED POSITION IS:$$'),

T(0) = HOURS;  /* SAVE TIME OF CALL */
T(1) = MINUTES;
T(2) = SECONDS;
OK = 0;
DO WHILE OK = 0;
  CALL CRT$PRINT$STRING(. TITLE#3);
  CALL SEND$CRLF;
  CALL CRT$PRINT$STRING(. MSG3);
  CALL SEND$CRLF;
  DESIG = GET$DESIG;
  INDEX = CHECK$DESIG(DESIG);
  IF INDEX = 0FFH
  THEN DO;
    CALL CRT$PRINT$STRING(. MSG4);
    CALL SEND$CRLF;
    CALL CHECK$GO$KEY;
  END;
ELSE DO;
  OK = 1;
END;

CALL CLEAR$LOW$SCREEN;
END;

CALL CRT$PRINT$STRING(. TITLE#3);
CALL SEND$CRLF;
CALL CRT$PRINT$STRING(. MSG#03);
CALL SEND$CRLF;
CALL DISPLAY$DESIG(DESIG);

```



```

CALL SEND$SPACE(15);
CALL DISPLAY$TYPE(, CONTACT$INFO(INDEX), TYPE);
CALL SEND$SPACE(6);
CALL DISPLAY$CLASS(, CONTACT$INFO(INDEX), KIND);
CALL SEND$CRLF;
CALL CRT$PRINT$STRING(, MSG5);
IF CONTACT$INFO(INDEX).FLAG
  THEN TEMP = 15;
  ELSE TEMP = (CONTACT$INFO(INDEX).POINTER MOD 15) + 1;
CALL BYTE$CHAR(TEMP);
CALL SEND$CRLF;
CALL SEND$CRLF;
CALL CHECK$GO$KEY;
CALL CLEAR$LOW$SCREEN;
CALL CRT$PRINT$STRING(, TITLE$3);
CALL SEND$CRLF;
CALL CRT$PRINT$STRING(, MSG$00);
CALL SEND$CRLF;
POINTER = CONTACT$INFO(INDEX).POINTER;
CALL CONV$LAT$LONG(, CONTACT$POSI(POINTER), X, CONTACT$POSI(POINTER), Y,
  , LAT, , LONG);
CALL DISPLAY$LAT$LONG(0, , LAT);
CALL SEND$SPACE(12);
CALL DISPLAY$LAT$LONG(1, , LONG);
CALL SEND$CRLF;
CALL DISPLAY$XY(0, , CONTACT$POSI(POINTER), X);
CALL SEND$SPACE(18);
CALL DISPLAY$XY(1, , CONTACT$POSI(POINTER), Y);
CALL SEND$CRLF;
CALL SEND$CRLF;
CALL CHECK$GO$KEY;

```



```

CALL CLEAR$LOW$SCREEN;
TEMP = GET$CPA(INDEX, ., STRING);
CALL CRT$PRINT$STRING(. TITLE$3);
CALL SEND$CRLF;
CALL CRT$PRINT$STRING(. MSG$01);
CALL DISPLAY$TIME(. CONTACT$POSI(P POINTER), TIME);
CALL SEND$CRLF;
CALL DISPLAY$CRS$BRG(1, . CONTACT$POSI(P POINTER), BRG);
CALL SEND$SPACE(20);
CALL DISPLAY$RNGE(. CONTACT$POSI(P POINTER), RNG);
CALL SEND$CRLF;
IF CONTACT$INFO(INDEX). CRS$FLAG
THEN DO;
    CALL DISPLAY$CRS$BRG(0, . CONTACT$POSI(P POINTER), CRS);
    CALL SEND$SPACE(20);
    END;
ELSE DO;
    CALL CRT$PRINT$STRING(. MSG$0);
    CALL SEND$SPACE(3);
    END;
IF CONTACT$INFO(INDEX). SPD$FLAG
THEN CALL DISPLAY$SPD(. CONTACT$POSI(P POINTER), SPD);
ELSE CALL CRT$PRINT$STRING(. MSG$1);
CALL SEND$CRLF;
CALL SEND$CRLF;
CALL CHECK$GO$KEY;
CALL CLEAR$LOW$SCREEN;
CALL CRT$PRINT$STRING(. TITLE$3);
CALL SEND$CRLF;
CALL CRT$PRINT$STRING(. MSG$02);
CALL SEND$CRLF;

```



```

IF TEMP = 0
THEN DO;
  CALL CRT$PRINT$STRING(.MSG2);
  CALL SEND$CRLF;
  END;
ELSE DO;
  IF STRING(14) < 3AH
  THEN DO;
    CALL CRT$PRINT$STRING(.TIME: $$');
    DO I = 7 TO 10;
      IF I = 9 THEN CALL CRT$WRITE(COLON);
      CALL CRT$WRITE(STRING(I));
      END;
    CALL SEND$SPACE(9);
    CALL CRT$PRINT$STRING(.BEARING: $$');
    DO I = 11 TO 14;
      IF I = 14 THEN CALL CRT$WRITE(POINT);
      CALL CRT$WRITE(STRING(I));
      END;
    CALL SEND$SPACE(9);
    CALL CRT$PRINT$STRING(.RANGE: $$');
    DO I = 15 TO 19;
      CALL CRT$WRITE(STRING(I));
      END;
    IF STRING(20) = 'M'
    THEN CALL CRT$PRINT$STRING(.MILES$$');
    ELSE CALL CRT$PRINT$STRING(.YARDS$$');
    CALL SEND$CRLF;
    END;
  ELSE DO;
    CALL SEND$SPACE(30);
  
```



```

IF STRING(14) = 'L'
THEN DO:
  CALL SEND$SPACE(5);
  CALL START$BLINK;
  CALL CRT$PRINT$STRING(, ('COLLISION AT $$'));
  STRING(12), STRING(13) = '$';
  STRING(11) = STRING(10);
  STRING(10) = STRING(9);
  STRING(9) = COLON;
  CALL CRT$PRINT$STRING(, STRING(7));
  CALL CRT$WRITE(18H); /* STOP BLINK */
END;
ELSE DO:
  IF STRING(14) = 'A'
  THEN CALL CRT$PRINT$STRING(, ('MOVING AWAY. $$'));
  ELSE CALL CRT$PRINT$STRING(, ('SAME COURSE AND SPEED. $$'));
  END;
  END;
END;
CALL SEND$CRLF;
CALL CHECK$GO$KEY;
CALL CLEAR$LOW$SCREEN;
CALL CRT$PRINT$STRING(, TITLE$3);
CALL SEND$CRLF;
CALL CRT$PRINT$STRING(, MSG6);
CALL SEND$CRLF;
CALL CRT$PRINT$STRING(, MSG6);
CALL SEND$CRLF;
IF CONTACT$INFO(, INDEX), CRS$FLAG AND
CONTACT$INFO(, INDEX), SPD$FLAG
THEN DO:
  IF T(0) < CONTACT$POSI(, POINTER), TIME(0)
  THEN T(0) = T(0) + 24;

```



```

/* FIND ESTIMATED TIME */
CALL CONV$CONTACT$TIME<T, .TIME#1>;
CALL CONV$CONTACT$TIME<CONTACT$POSI<POINTER>.TIME, .TIME#2>;
CALL FSUB<.TIME#1, .TIME#2, .TIME#1>;

/* FIND ESTIMATED DISTANCE TRAVELED BY CONTACT */
CALL FMUL<.CONTACT$POSI<POINTER>.SPD, .TIME#1, .DISTANCE>;
CALL FMUL<.DEG$TO$RAD, .CONTACT$POSI<POINTER>.CRS, .BRG>;
CALL COS$SIN<.BRG, .COS$DIST, .SIN$DIST>;
CALL FMUL<.DISTANCE, .COS$DIST, .Y$DELTA>;
CALL FMUL<.DISTANCE, .SIN$DIST, .X$DELTA>;
CALL FADD<.Y$DELTA, .CONTACT$POSI<POINTER>.Y, .Y$DELTA>;
CALL FADD<.X$DELTA, .CONTACT$POSI<POINTER>.X, .X$DELTA>;
TEMP = OWN$SHIP$INFO.POINTER;
CALL FSUB<.Y$DELTA, .OWN$SHIP<TEMP>.Y, .Y$DELTA>;
CALL FSUB<.X$DELTA, .OWN$SHIP<TEMP>.X, .X$DELTA>;

/* FIND ESTIMATED BEARING */
CALL ARC$TAN<.Y$DELTA, .X$DELTA, .BRG>;
CALL FDIV<.BRG, .DEG$TO$RAD, .BRG>;

/* FIND ESTIMATED RANGE */
CALL FSQR<.Y$DELTA, .Y$DELTA>;
CALL FSQR<.X$DELTA, .X$DELTA>;
CALL FADD<.Y$DELTA, .X$DELTA, .RNG>;
CALL FSQRT<.RNG, .RNG>;

/* PRINT ESTIMATED VALUES */
CALL DISPLAY$CRS$BRG<1, .BRG>;
CALL SEND$SPACE<20>;
CALL DISPLAY$RANGE<.RNG>;
END;

ELSE DO;
CALL CRT$PRINT$STRING<.MSG00>;
CALL SEND$SPACE<3>;

```


DISPLAY\$CMDS

DISPLAY\$CONTACT\$INFO

```
CALL CRT$PRINT$STRING(C.MSG1);  
END;  
CALL SEND$CRLF;  
CALL SEND$CRLF;  
CALL CHECK$GO$KEY;  
CALL CLEAR$LOW$SCREEN;  
END DISPLAY$CONTACT$INFO;
```



```

/*****
*
* DISPLAY$SYSTEM:
* THIS PROCEDURE IS USED TO DISPLAY THE DESIGNATIONS OF ALL THE CONTACTS
* THAT ARE BEING MAINTAINED BY THE SYSTEM.
*
*****/
DISPLAY$SYSTEM: PROCEDURE PUBLIC;
    DCL BUFFER (18) BYTE,
        I BYTE;
    DCL M0 (*) BYTE DATA
        ('THE FOLLOWING CONTACTS ARE BEING MAINTAINED BY THE SYSTEM:$$');

    DO I = 0 TO LAST(BUFFER);
        BUFFER(I) = ' ';
    END;

    BUFFER(16), BUFFER(17) = '$';
    CALL CRT$PRINT$STRING(, TITLE#4);
    CALL SEND$CRLF;
    CALL CRT$PRINT$STRING(, M0);
    CALL SEND$CRLF;
    DO I = 0 TO 14;
        IF CONTACT$INFO(I).DESIG <> 00H
            THEN DO;
                CALL DE$HASH(CONTACT$INFO(I).DESIG, , BUFFER(10));
                CALL CRT$PRINT$STRING(, BUFFER);
            END;
    END;

    CALL SEND$CRLF;
    CALL CHECK$GO$KEY;
    CALL CLEAR$LOW$SCREEN;

```


DISPLAY\$SYSTEM

DISPLAY\$CMDS

END DISPLAY\$SYSTEM;


```

/*****
*
* DISPLAY$SAFE$RNG:
* THIS PROCEDURE IS USED TO PRESENT TO THE OPERATOR THE CURRENT VALUE OF
* THE SAFE C. P. A. RANGE.
*
*****/
DISPLAY$SAFE$RNG: PROCEDURE PUBLIC;
CALL CRT$PRINT$STRING(, TITLE$5);
CALL SEND$CRLF;
CALL SEND$CRLF;
CALL DISPLAY$RANGE(, SAFE$RNG);
CALL SEND$CRLF;
CALL SEND$CRLF;
CALL CHECK$GO$KEY;
CALL CLEAR$LOW$SCREEN;
END DISPLAY$SAFE$RNG;

```



```

/*****
* DISPLAY$WIND:
* THIS PROCEDURE IS USED TO DISPLAY INFORMATION ABOUT THE WIND.
*
*****/
DISPLAY$WIND: PROCEDURE PUBLIC;
  DCL STRING (6) BYTE,
    (TEMP, I) BYTE;
  DCL MSG0 (*) BYTE DATA ('WIND DIRECTION:  $$'),
    MSG1 (*) BYTE DATA ('WIND SPEED:  $$');

  CALL CRT$PRINT$STRING(, TITLE$6);
  CALL SEND$CRLF;
  CALL SEND$CRLF;
  CALL CRT$PRINT$STRING(, MSG0);
  TEMP = FP$FORMAT(, SYSTEM.WIND$DIR, , STRING, 3, 1);
  DO I = 0 TO 3;
    IF I = 3 THEN CALL CRT$WRITE(POINT);
    CALL CRT$WRITE(STRING(I));
  END;
  CALL SEND$CRLF;
  CALL CRT$PRINT$STRING(, MSG1);
  TEMP = FP$FORMAT(, SYSTEM.WIND$SPD, , STRING, 2, 1);
  DO I = 0 TO 2;
    IF I = 2 THEN CALL CRT$WRITE(POINT);
    CALL CRT$WRITE(STRING(I));
  END;
  CALL SEND$CRLF;
  CALL SEND$CRLF;
  CALL CHECK$GO$KEY;

```


DISPLAY\$WIND

DISPLAY\$CMDS

CALL CLEAR\$LOW\$SCREEN;
END DISPLAY\$WIND;

DISPLAY\$CMDS

DISPLAY\$UPDATE\$TIME

```
/*
*****
* DISPLAY$UPDATE$TIME:
* THIS PROCEDURE IS USED TO DISPLAY THE TIME BETWEEN UPDATES.
*
*****
DISPLAY$UPDATE$TIME: PROCEDURE (TEMP$TIME) PUBLIC;
    DCL TEMP$TIME BYTE;
    DCL M0 (*) BYTE DATA
        ('THE TIME BETWEEN UPDATES IS $$'),
    M1 (*) BYTE DATA
        (' SECONDS. $$');

    CALL CRT$PRINT$STRING(, TITLE$7);
    CALL SEND$CRLF;
    CALL CRT$PRINT$STRING(, M0);
    CALL BYTE$CHAR(TEMP$TIME);
    CALL CRT$PRINT$STRING(, M1);
    CALL SEND$CRLF;
    CALL SEND$CRLF;
    CALL CHECK$GO$KEY;
    CALL CLEAR$LOW$SCREEN;
    END DISPLAY$UPDATE$TIME;

END DISPLAY$CMDS;
```


COMMANDS: DO;

CRT\$READ:
 PROCEDURE BYTE EXTERNAL;
 END;

CRT\$PRINT\$STRING:
 PROCEDURE (A) EXTERNAL;
 DECLARE A ADDRESS; END;

CRT\$WRITE:
 PROCEDURE (A) EXTERNAL;
 DECLARE A BYTE; END;

SEND\$CR:
 PROCEDURE EXTERNAL;
 END;

SEND\$EEL:
 PROCEDURE EXTERNAL;
 END;

SEND\$BS:
 PROCEDURE EXTERNAL;
 END;

SEND\$SUB:
 PROCEDURE EXTERNAL;


```

END;

SEND$CRLF:
  PROCEDURE EXTERNAL;
END;

GET$STRING:
  PROCEDURE (A,B) EXTERNAL;
  DECLARE A ADDRESS, B BYTE; END;

PUT$NUMBER$BUFFER:
  PROCEDURE (A,B) EXTERNAL;
  DECLARE A BYTE, B ADDRESS; END;

ASCII$TO$FLOAT:
  PROCEDURE (A,B,C) EXTERNAL;
  DECLARE (A,C) ADDRESS, B BYTE; END;

FLOAT$TO$ASCII:
  PROCEDURE (A,B,C) EXTERNAL;
  DECLARE (A,B,C) ADDRESS; END;

CLEAR$LOW$SCREEN:
  PROCEDURE EXTERNAL;
END;

FADD:
  PROCEDURE (A,B,C) EXTERNAL;
  DECLARE (A,B,C) ADDRESS; END;

FSUB:

```



```
PROCEDURE (A,B,C) EXTERNAL;
DECLARE (A,B,C) ADDRESS; END;
```

```
FMUL:
  PROCEDURE (A,B,C) EXTERNAL;
  DECLARE (A,B,C) ADDRESS; END;
```

```
FDIV:
  PROCEDURE (A,B,C) EXTERNAL;
  DECLARE (A,B,C) ADDRESS; END;
```

```
EDIV:
  PROCEDURE (A,B,C,D) EXTERNAL;
  DECLARE (A,B,C,D) ADDRESS; END;
```

```
FLTDS:
  PROCEDURE (A,B) EXTERNAL;
  DECLARE (A,B) ADDRESS; END;
```

```
FIXSD:
  PROCEDURE (A,B) EXTERNAL;
  DECLARE (A,B) ADDRESS; END;
```

```
FCMPR:
  PROCEDURE (A,B,C) BYTE EXTERNAL;
  DECLARE (A,B) ADDRESS, C BYTE; END;
```

```
FZTST:
  PROCEDURE (A,B) BYTE EXTERNAL;
  DECLARE (A,B) ADDRESS; END;
```


DECLARE LIT LITERALLY 'LITERALLY',

DCL LIT 'DECLARE';

DCL POINT LIT '2EH',

/* DECIMAL POINT. */

ETEOL LIT '17H';

/* ERASE TO END OF LINE. */

DCL

FP#0#25 (4) BYTE DATA (00H, 00H, 00H, 3EH),

FP#2 (4) BYTE DATA (00H, 00H, 00H, 40H),

FP#5 (4) BYTE DATA (00H, 00H, 0A0H, 040H),

FP#25 (4) BYTE DATA (00H, 00H, 0C8H, 41H),

FP#60 (4) BYTE DATA (00H, 00H, 70H, 42H),

FP#90 (4) BYTE DATA (00H, 00H, 0B4H, 42H),

FP#100 (4) BYTE DATA (00H, 00H, 0C8H, 042H),

FP#180 (4) BYTE DATA (00H, 00H, 34H, 43H),

FP#360 (4) BYTE DATA (00FH, 0FFH, 0E3H, 043H),

FP#2000 (4) BYTE DATA (0E4H, 2EH, 0FDH, 044H),

FP#202500 (4) BYTE DATA (04AH, 0CAH, 045H, 048H),

FP#59#9 (4) BYTE DATA (9AH, 99H, 6FH, 42H),

FP#99#9 (4) BYTE DATA (0CDH, 0CCH, 0C7H, 042H),

FP#MIN#T0#RAD (4) BYTE DATA (98H, 82H, 96H, 39H);

/* 2025.3716 */

/* 202537.15625 */

/* 0.00029089 */


```

/*****
*
* PRINT$ERROR$MSG:
* THIS PROCEDURE IS USED TO PRINT AN ERROR MESSAGE FOR INVALID INPUT.
* IT WILL ALSO RETURN THE CURSOR TO THE BEGINNING OF THE SAME LINE.
*
*****/
PRINT$ERROR$MSG: PROCEDURE;
    DCL MSG(*) BYTE DATA ( ' *** BAD FORMAT. ***$' );
    CALL SEND$BEL;
    CALL CRT$PRINT$STRING( MSG );
    CALL SEND$CR;
    CALL SEND$SUB;
    END PRINT$ERROR$MSG;

```



```

/*****
*
* CHECK$YES$NO:
* PROCEDURE USED TO CHECK FOR A VALID YES/NO INPUT FROM THE CRT.
*
* USAGE:
* TYPED PROCEDURE. A VALUE OF 1 WILL BE RETURNED IF THE ANSWER IS 'YES',
* OTHERWISE, THE VALUE RETURNED IS 0.
*
*****/
CHECK$YES$NO: PROCEDURE BYTE PUBLIC;
    DCL CHAR BYTE;
    CHAR = CRT$READ;
    DO WHILE (CHAR <> 'Y') AND (CHAR <> 'N') /* UPPER CASE. */
        AND (CHAR <> 'y') AND (CHAR <> 'n'); /* LOWER CASE. */
    CALL SEND$BEL;
    CHAR = CRT$READ;
    END;
    IF (CHAR = 'Y') OR (CHAR = 'y')
    THEN DO;
        CALL CRT$PRINT$STRING( ('YES$'));
        RETURN 1;
    END;
    ELSE DO;
        CALL CRT$PRINT$STRING( ('NO $'));
        RETURN 0;
    END;
    END CHECK$YES$NO;

```


COMMANDS

CHECK\$FP\$VALUE

```

/*****
*
* CHECK$FP$VALUE:
* THIS PROCEDURE IS USED TO CHECK A GIVEN VALUE AGAINST A GIVEN LIMIT.
*
* PARAMETERS:
*   - A. - POINTER TO A FP VALUE.
*   - B. - POINTER TO A FP VALUE DENOTING THE LIMIT.
*
* USAGE:
*   TYPED PROCEDURE. A VALUE OF 00H WILL BE RETURNED IF THE VALUE IS GREATER
*   THAN THE GIVEN LIMIT. OTHERWISE A VALUE OF 001H WILL BE RETURNED.
*
*****/
CHECK$FP$VALUE: PROCEDURE (A,B) BYTE PUBLIC
  DCL (A,B) ADDRESS,
    (CHECK, TWO) BYTE
    TWO = 2;
  IF (CHECK: = FCMFR(A,B)..TWO))
  THEN DO;
    CALL PRINT$ERROR$MSG;
    RETURN 0;
  END;
ELSE DO;
  CALL CRT$WRITE(ETEOL);
  RETURN 1;
END;
END CHECK$FP$VALUE;
/* ERASE TO THE END OF LINE */

```


COMMANDS

CHECK\$INPUT

```

/*****
*
* CHECK$INPUT:
*   PROCEDURE USED TO CHECK THE VALIDITY OF THE INPUT PRESENT AT THAT MOMENT
*   IN THE SCREEN
*
*****/
CHECK$INPUT: PROCEDURE BYTE PUBLIC;
  DCL CHAR BYTE;
  CALL CRT$PRINT$STRINGC, ('IS THE INPUT CORRECT? (Y/N)  $$');
  CHAR = CHECK$YES$NO;
  RETURN CHAR;
END CHECK$INPUT;

```



```

/*****
*
* GET$DEGREES:
* THIS PROCEDURE IS USED TO OBTAIN 2 OR 3 NUMERIC CHARACTERS FROM THE CRT
* THAT REPRESENT A VALUE IN DEGREES OF LATITUDE OR LONGITUDE RESPECTIVELY.
*
* PARAMETERS:
* - NUM. - NUMBER OF NUMERIC CHARACTERS DESIRED. (2 OR 3 ONLY)
* - A. - POINTER TO A MEMORY LOCATION IN WHICH THE RESULT IS DESIRED.
*
* USAGE:
* THE FLOATING POINT REPRESENTATION OF THE DEGREES, WILL BE RETURNED CON-
* VERTED TO MINUTES OF LAT OR LONG.
*
*****/
GET$DEGREES: PROCEDURE (NUM,A) PUBLIC;
DCL A ADDRESS,
      NUMBER BASED A (4) BYTE,
      (NUM, OK) BYTE,
      BUFFER(6) BYTE;
  BUFFER(0), BUFFER(1) = NUM;
  BUFFER(NUM + 2) = 0;
  OK = 0;
  DO WHILE OK = 0;
    CALL CRT$PRINT$STRING(, ('DEGREES: ', $$(1)));
    CALL PUT$NUMBER$BUFFER(NUM, BUFFER(2));
    CALL ASCII$TO$FLOAT(, BUFFER, NUM + 3, NUMBER);
    IF NUM = 2
      THEN OK = CHECK$FP$VALUE(, NUMBER, , FP$90);
      ELSE OK = CHECK$FP$VALUE(, NUMBER, , FP$180);
  END;

```


COMMANDS

GET\$DEGREES

```
CALL FNUL(.NUMBER,.FP$50,.NUMBER);  
END GET$DEGREES;
```


COMMANDS

GET\$MINUTES

```

/*****
*
* GET$MINUTES:
* THIS PROCEDURE IS USED TO GET FROM THE CRT, THREE NUMERIC CHARACTERS RE-
* PRESENTING THE VALUE OF MINUTES. THIS PROCEDURE WILL PROMPT FOR TWO
* INTEGERS AND ONE DECIMAL VALUE.
*
* PARAMETERS:
* - A - POINTER TO A MEMORY LOCATION IN WHICH THE FP REPRESENTATION OF THE
* CHARACTERS OBTAINED, IS DESIRED TO BE PLACED.
*
*****/
GET$MINUTES: PROCEDURE (A) PUBLIC;
    DCL A ADDRESS,
        NUMBER BASED A (4) BYTE,
        BUFFER(6) BYTE,
        OK BYTE;
    BUFFER(0) = 3;
    BUFFER(1) = 2;
    BUFFER(5) = 0;
    OK = 0;
    DO WHILE OK = 0;
        CALL CRT$PRINT$STRING(,'MINUTES:  $$$');
        CALL PUT$NUMBER$BUFFER(2,.BUFFER(2));
        CALL CRT$WRITE(POINT);
        CALL PUT$NUMBER$BUFFER(1,.BUFFER(4));
        CALL ASCII$TO$FLOAT(.BUFFER,6,.NUMBER);
        OK = CHECK$FP$VALUE(.NUMBER,.FP$59$9);
    END;
END GET$MINUTES;

```



```

/*****
*
* GET$SIGN:
* THIS PROCEDURE IS USED TO GET FROM THE CRT, A CHARACTER THAT WILL REPRESENT THE N/S LATITUDE OR E/W LONGITUDE.
*
* PARAMETERS:
* - T1,T2 - ASCII CHARACTERS REPRESENTING THE VALUES AGAINST WHICH THE INPUT FROM THE CRT IS DESIRED TO BE COMPARED.
*
* USAGE:
* TYPED PROCEDURE. A VALUE OF 1 WILL BE RETURNED IF THE INPUT FROM THE CRT IS EQUAL TO THE VALUE OF T1, OTHERWISE A VALUE OF 0 WILL BE RETURNED.
*
*****/
GET$SIGN: PROCEDURE (T1,T2) BYTE PUBLIC;
  DCL (T1,T2,SIGN) BYTE;
  SIGN = 0;
  DO WHILE (SIGN <> T1) AND (SIGN <> T2);
    CALL CRT$PRINT$STRING(,('SIGN: '$$'));
    CALL GET$STRING(,SIGN,1);
    IF (SIGN <> T1) AND (SIGN <> T2)
      THEN CALL PRINT$ERROR$MSG;
    ELSE CALL CRT$WRITE(,TEOL);
  END;
  IF SIGN = T1 THEN RETURN 1;
  ELSE RETURN 0;
END GET$SIGN;

```



```

/*****
*
* FP$FORMAT:
* THIS PROCEDURE IS USED TO OBTAIN AN SPECIFIED NUMBER OF ASCII CHARAC-
* TERS REPRESENTING A NUMERIC VALUE IN FP FORNAT.
*
* PARAMETERS:
*   - A. - POINTER TO A 4 BYTE VECTOR CONTAINING A FP NUMBER.
*   - B. - POINTER TO A MEMORY LOCATION IN WHICH THE STRING OF ASCII CHARAC-
*     TERS IS DESIRED TO BE PLACED.
*   - NUMINT. - NUMBER OF CHARACTERS REPRESENTING THE DESIRED INTEGER
*     PORTION.
*   - NUMDEC. - SIMILAR TO NUMINT, BUT REPRESENTING THE DECIMAL PORTION
*     DESIRED.
*
* USAGE:
*   TYPED PROCEDURE. IF THE SIGN OF THE GIVEN FP NUMBER IS POSITIVE, A
*   VALUE OF 0 IS RETURNED, OTHERWISE, A 1 IS RETURNED.
*
*****/
FP$FORMAT: PROCEDURE (A,B,NUMINT,NUMDEC) BYTE PUBLIC;
  DCL (A,B) ADDRESS,
    FP$NUM BASED A (4) BYTE,
    STRING BASED B (16) BYTE,
    BUFFER (28) BYTE,
    (NUMINT,NUMDEC,NUM,SIGN,I,J,M,M1) BYTE;
  N1 = 0;
  DO I = 0 TO NUMINT + NUMDEC;
    STRING (I) = '0';
  END;
  CALL FLOAT$TO$ASCII(.FP$NUM.,BUFFER,NUM);

```



```

DO I = NUM TO 27;
  BUFFER(I) = '0';
END;

IF BUFFER(0) = ' '
  THEN SIGN = 0;
  ELSE SIGN = 1;

I = 1;
DO WHILE BUFFER(I) <> POINT;
  N1 = N1 + 1;
  I = I + 1;
END;

IF N1 > NUMINT
  THEN DO;
    CALL CRT$PRINT$STRING('NUMBER TOO LARGE. $$');
    HALT;
  END;

I = 1;
J = NUMINT - N1;
N = NUMINT + NUMDEC;
DO WHILE N > 0;
  IF BUFFER(I) = POINT THEN I = I + 1;
  STRING(J) = BUFFER(I);
  J = J + 1;
  I = I + 1;
  N = N - 1;
END;

IF (BUFFER(I) >= '5') AND (STRING(J-1) <> '9') /* TO "ROUND". */
  THEN STRING(J-1) = STRING(J-1) + 1;
N = NUMINT + NUMDEC;
STRING(N), STRING (N + 1) = '$';
RETURN SIGN;

```


FP\$FORMAT

COMMANDS

END FP\$FORMAT;


```

/*****
*
* RANGE$FORMAT:
* THIS PROCEDURE IS USED TO OBTAIN IN ASCII CHARACTERS, THE VALUE OF A
* FP NUMBER REPRESENTING A RANGE. IF THE VALUE IS LESS THAN OR EQUAL TO 5
* MILES, THEN THE RANGE WILL BE GIVEN IN YARDS, OTHERWISE, IT WILL BE GIVEN
* IN MILES.
*
* PARAMETERS:
* - A - POINTER TO A 4 BYTE VECTOR REPRESENTING A FP NUMBER.
* - B - POINTER TO A MEMORY LOCATION IN WHICH THE STRING IS DESIRED TO BE
* PLACED.
*
*****/
RANGE$FORMAT: PROCEDURE (A,B) PUBLIC;
  DCL (A,B) ADDRESS,
    VALUE BASED A (4) BYTE,
    STRING BASED B (6) BYTE,
    RESULT (4) BYTE,
    (TEMP, TWO) BYTE;
  TWO = 2;
  IF (TEMP := FCMPR(A, FP$5, TWO))
  THEN DO;
    TEMP = FP$FORMAT(.VALUE, .STRING(0), 3, 1);
    STRING(4) = STRING(3);
    STRING(3) = POINT;
    STRING(5) = 'N';
    END;
  ELSE DO;
    CALL FMUL(.VALUE, .FP$2000, .RESULT);
    TEMP = FP$FORMAT(.RESULT, .STRING(0), 5, 0);

```



```

    STRING(5) = 'Y'
  END
  END RANGE$FORMAT;

```



```

/*****
*
* LAT$LONG$FORMAT:
* THIS PROCEDURE IS USED TO CONVERT A FLOATING POINT VALUE REPRESENTATION
* OF LAT/LONG IN MINUTES, INTO A CORRESPONDING STRING OF CHARACTERS.
*
* PARAMETERS:
* - A - POINTER TO A MEMORY LOCATION CONTAINING A FP VALUE.
* - B - POINTER TO A MEMORY LOCATION IN WHICH THE STRING OF ASCII CHARAC-
* TERS IS DESIRED TO BE PLACED.
* - TYPE - CAN HAVE ONE OF TWO VALUES: 0 ---> LATITUDE DESIRED.
* 1 ---> LONGITUDE DESIRED.
*
*****/
LAT$LONG$FORMAT: PROCEDURE (A,B,TYPE) PUBLIC;
DCL (A,B) ADDRESS,
    SIXTY ADDRESS DATA (000),
    LAT$LONG BASED A (4) BYTE,
    STRING BASED B (9) BYTE,
    BUFFER(28) BYTE,
    VALUE (4) BYTE,
    TEMP (4) BYTE,
    TEMP1 (4) BYTE,
    REM (4) BYTE,
    (NUM,I,SIGN,TYPE,J,TEST) BYTE;
SIGN = 0;
DO I = 0 TO 3;
    VALUE(I) = LAT$LONG(I);
END;
IF LAT$LONG(3) >= 000H
THEN DO;

```



```

SIGN = 1;
VALUE(3) = VALUE(3) XOR 080H;
END;

CALL FIXED(.VALUE,.TEMP);
CALL EDIV(.TEMP,.SIXTY,.TEMP1,.REM);
CALL FLTDS(.TEMP1,.TEMP1);
TEST = FP$FORMAT(.TEMP1,.STRING,3,0);
CALL FLTDS(.REM,.REM);
CALL FLTDS(.TEMP,.TEMP);
CALL FSUB(.VALUE,.TEMP,.TEMP);
CALL FADD(.TEMP,.REM,.TEMP);
TEST = FP$FORMAT(.TEMP,.STRING(3),2,1);
IF TYPE = 0
THEN DO;
  IF SIGN = 1 THEN STRING(6) = 'S';
  ELSE STRING(6) = 'N';
END;
ELSE DO;
  IF SIGN = 1 THEN STRING(6) = 'W';
  ELSE STRING(6) = 'E';
END;
STRING(7),STRING(8) = '$';
END LAT$LONG$FORMAT;

```


COMMANDS

GET\$TIME\$ZONE

```

/*****
*
* GET$TIME$ZONE:
* THIS PROCEDURE IS USED TO OBTAIN A STRING OF ASCII CHARACTERS FROM
* THE CRT, REPRESENTING THE VALUE AND SIGN OF THE TIME ZONE.
*
* PARAMETERS:
* - A - POINTER TO A MEMORY LOCATION IN WHICH THE STRING IS DESIRED TO
* BE PLACED.
*
*****/
GET$TIME$ZONE: PROCEDURE (A) PUBLIC;
    DCL A ADDRESS,
        RESULT BASED A (5) BYTE,
        <OK, SIGN, TEMP, VALUE> BYTE;
    OK = 0;
    DO WHILE OK = 0;
        CALL CRT$PRINT$STRING<('ENTER THE TIME ZONE VALUE AS REQUESTED:$$')>;
        CALL SEND$CRLF;
        CALL CRT$PRINT$STRING<('SIGN: $$')>;
        SIGN = CRT$READ;
        DO WHILE (SIGN <> '+' ) AND (SIGN <> '-');
            CALL SEND$BEL;
            SIGN = CRT$READ;
        END;
        RESULT(0) = SIGN;
        CALL CRT$WRITE<(SIGN)>;
        CALL SEND$CRLF;
        TEMP = 0;
        DO WHILE TEMP = 0;
            CALL CRT$PRINT$STRING<('VALUE: $$')>;

```


COMMANDS

GET\$TIME\$ZONE

```

CALL PUT$NUMBER$BUFFER(2, RESULT(1));
VALUE = ((RESULT(1) - 30H) * 10) + (RESULT(2) - 30H);
IF VALUE > 12 THEN CALL PRINT$ERROR$MSG;
ELSE DO;
    CALL CRT$WRITE(ETEOL);
    TEMP = 1;
    END;
END;
CALL SEND$CRLF;
OK = CHECK$INPUT;
CALL CLEAR$LOW$SCREEN;
END;
RESULT(3), RESULT(4) = '$';
END GET$TIME$ZONE;

```



```

/*****
*
* GET$LAT:
*   PROCEDURE USED TO OBTAIN THE VALUES OF LATITUDE.
*
* PARAMETERS:
*   - A - POINTER TO MEMORY LOCATION IN WHICH THE FP REPRESENTATION
*     OF THE VALUE OF THE LATITUDE IN MINUTES IS DESIRED TO BE PLACED.
*
*****/
GET$LAT: PROCEDURE (A) PUBLIC;
    DCL A ADDRESS,
        RESULT BASED A (4) BYTE,
        OP1 (4) BYTE,
        OP2 (4) BYTE,
        (SIGN,OK,TEST,FIVE) BYTE;
    FIVE = 5;
    OK = 0;
    DO WHILE OK = 0;
        CALL CRT$PRINT$STRING(,'ENTER THE LATITUDE VALUE AS REQUESTED:$$');
        CALL SEND$CRLF;
        CALL GET$DEGREES(2,,OP1);
        CALL SEND$CRLF;
        CALL GET$MINUTES(,OP2);
        CALL SEND$CRLF;
        CALL FADD(,OP1,,OP2,,RESULT);
        SIGN = GET$SIGN('N','S');
        IF SIGN = 0'
            THEN DO;
                IF (TEST:= FZ1ST(,RESULT,,FIVE)) THEN
                    RESULT(3) = RESULT(3) XOR 080H;

```



```
      CALL CRT$PRINT$STRING(, ('OUTH. $$'));  
      END;  
      ELSE CALL CRT$PRINT$STRING(, ('ORTH. $$'));  
      CALL SEND$CRLF;  
      OK = CHECK$INPUT;  
      CALL CLEAR$LOW$SCREEN;  
      END;  
      END GET$LAT;
```



```

/*****
*
* GET$LONG:
* PROCEDURE USED TO OBTAIN THE FP REPRESENTATION OF THE LONGITUDE IN
* MINUTES.
*
* PARAMETERS:
* - A - POINTER TO A MEMORY LOCATION IN WHICH THE VALUE OF THE
* LONGITUDE IN MINUTES IS DESIRED TO BE STORED.
*
*****/
GET$LONG: PROCEDURE (A) PUBLIC;
DCL A ADDRESS,
      RESULT BASED A (4) BYTE,
      OP1 (4) BYTE,
      OP2 (4) BYTE,
      (SIGN, OK, TEST, FIVE) BYTE;
      FIVE = 5;
      OK = 0;
      DO WHILE OK = 0;
        CALL CRT$PRINT$STRING(, ('ENTER THE LONGITUDE VALUE AS REQUESTED:$$'));
        CALL SEND$CRLF;
        CALL GET$DEGREES(3, OP1);
        CALL SEND$CRLF;
        CALL GET$MINUTES(, OP2);
        CALL SEND$CRLF;
        CALL FADD(, OP1, OP2, RESULT);
        SIGN = GET$SIGN('E', 'W');
        IF SIGN = 0
          THEN DO;
            CALL CRT$PRINT$STRING(, ('EST$$'));

```


COMMANDS

GET\$LONG

```

IF (TEST:= F2TST(.RESULT,.FIVE)) THEN
  RESULT(3) = RESULT(3) XOR 080H;
END;
ELSE CALL CRT$PRINT$STRING(.('AST$$'));
CALL SEND$CRLF;
OK = CHECK$INPUT;
CALL CLEAR$LOW$SCREEN;
END;
END GET$LONG;

```


COMMANDS

GET\$COURSE\$BERG

```

/*****
*
* GET$COURSE$BERG:
* THIS PROCEDURE IS USED TO OBTAIN THE VALUE OF COURSE OR BEARING FROM
* THE CRT.
*
* PARAMETERS:
* - TYPE. - HAS TWO POSSIBLE VALUES: IF 0 ---> GET COURSE.
*           IF 1 ---> GET BEARING.
* - A. - POINTER TO A MEMORY LOCATION IN WHICH THE FLOATING POINT REPRESENTATION OF THE VALUE OF THE COURSE OR BEARING, IN DEGREES, IS DESIRED TO BE PLACED.
*
*****/
GET$COURSE$BERG: PROCEDURE (TYPE,A) PUBLIC;
  DCL A ADDRESS,
        RESULT BASED A (4) BYTE,
        BUFFER(7) BYTE,
        (TEMP, OK, TYPE) BYTE;
  OK = 0;
  BUFFER(0) = 4;
  BUFFER(1) = 3;
  BUFFER(6) = 0;
  DO WHILE OK = 0;
    CALL CRT$PRINT$STRING(, ('ENTER THE $$$'));
    IF TYPE = 0
      THEN CALL CRT$PRINT$STRING(, ('COURSE $$$'));
    ELSE CALL CRT$PRINT$STRING(, ('BEARING $$$'));
    CALL CRT$PRINT$STRING(, ('VALUE AS REQUESTED: $$$'));
    CALL SEND$CRLF;
    TEMP = 0;
  
```



```
DO WHILE TEMP = 0;
  CALL CRT$PRINT$STRING(,('DEGREES:  '$'));
  CALL PUT$NUMBER$BUFFER(3,,BUFFER(2));
  CALL CRT$WRITE(POINT);
  CALL PUT$NUMBER$BUFFER(1,,BUFFER(5));
  CALL ASCII$TO$FLOAT(,BUFFER,7,,RESULT);
  TEMP = CHECK$FP$VALUE(,RESULT,,FP$360);
END;
CALL SEND$CRLF;
OK = CHECK$INPUT;
CALL CLEAR$LOW$SCREEN;
END;
END GET$COURSE$BRG;
```


COMMANDS

GET\$SPEED

```

/*****
*
* GET$SPEED:
* THIS PROCEDURE IS USED TO OBTAIN THE SPEED VALUE FROM THE CRT.
*
* PARAMETERS:
* - A - POINTER TO A MEMORY LOCATION IN WHICH THE FLOATING POINT REPRESENTATION OF THE VALUE OF THE SPEED IN KNOTS, IS DESIRED TO BE PLACED.
*
*****/
GET$SPEED: PROCEDURE (A) PUBLIC;
    DCL A ADDRESS,
        RESULT BASED A (4) BYTE,
        BUFFER(6) BYTE,
        (TEMP, OK) BYTE;
    OK = 0;
    BUFFER(0) = 3;
    BUFFER(1) = 2;
    BUFFER(5) = 0;
    DO WHILE OK = 0;
        CALL CRT$PRINT$STRING(, 'ENTER THE SPEED VALUE AS REQUESTED:$( ');
        CALL SEND$CRLF;
        TEMP = 0;
        DO WHILE TEMP = 0;
            CALL CRT$PRINT$STRING(, 'KNOTS: $( ');
            CALL PUT$NUMBER$BUFFER(2, BUFFER(2));
            CALL CRT$WRITE(POINT);
            CALL PUT$NUMBER$BUFFER(1, BUFFER(4));
            CALL ASCII$TO$FLOAT(, BUFFER, 6, RESULT);
            TEMP = CHECK$FP$VALUE(, RESULT, FP$99$9);
        END;
    END;

```


COMMANDS

GET\$SPEED

```
CALL SEND$CRLF;  
OK = CHECK$INPUT;  
CALL CLEAR$LOW$SCREEN;  
END;  
END GET$SPEED;
```



```

/*****
*
* GET$RANGE:
* THIS PROCEDURE IS USED TO OBTAIN THE FLOATING POINT REPRESENTATION OF
* A RANGE VALUE OBTAINED FROM THE CRT.
*
* PARAMETERS:
* - A - POINTER TO A MEMORY LOCATION IN WHICH THE FLOATING POINT REPRESENTATION OF THE VALUE OF A RANGE, IS DESIRED TO BE PLACED.
*
* USAGE:
* ALTHOUGH THIS PROCEDURE WILL ACCEPT EITHER YARDS OR MILES AS UNITS OF
* RANGE, THE RESULT WILL BE GIVEN IN TERMS OF MILES ONLY.
*
*****/
GET$RANGE: PROCEDURE (A) PUBLIC;
  DCL A ADDRESS,
    RESULT BASED A (4) BYTE,
    BUFFER (8) BYTE,
    (TEMP, OK, CHAR, UNITS) BYTE;

  OK = 0;
  DO WHILE OK = 0;
    CALL CRT$PRINT$STRING(, ('ENTER THE RANGE VALUE AS REQUESTED:$$'));
    CALL SEND$CRLF;
    CALL CRT$PRINT$STRING(, ('ENTER THE UNITS TO BE USED: (M/Y) $$'));
    CHAR = CRT$READ;
    DO WHILE (CHAR <> 'Y') AND (CHAR <> 'M') /* UPPER CASE CHARACTERS. */
      AND (CHAR <> 'y') AND (CHAR <> 'm') /* LOWER CASE CHARACTERS. */
      CALL SEND$BEL;
    CHAR = CRT$READ;
  END;

```



```

IF CHAR >= 61H THEN CHAR = CHAR - 020H;
IF CHAR = 'Y' THEN CALL CRT$PRINT$STRING(, ('YARDS, $$'));
    ELSE CALL CRT$PRINT$STRING(, ('MILES, $$'));
CALL SEND$CRLF;
TEMP = 0;
DO WHILE TEMP = 0;
    IF CHAR = 'Y'
    THEN DO;
        CALL CRT$PRINT$STRING(, ('YARDS: $$'));
        CALL PUT$NUMBER$BUFFER(6, BUFFER(2));
        BUFFER(0), BUFFER(1) = 6;
        BUFFER(8) = 0;
        CALL ASCII$TO$FLOAT(, BUFFER, 9, RESULT);
        TEMP = CHECK$FP$VALUE(, RESULT, FP$202500);
        CALL FDIV(, RESULT, FP$2000, RESULT);
        END;
    ELSE DO;
        CALL CRT$PRINT$STRING(, ('MILES: $$'));
        CALL PUT$NUMBER$BUFFER(3, BUFFER(2));
        CALL CRT$WRITE(POINT);
        CALL PUT$NUMBER$BUFFER(1, BUFFER(5));
        BUFFER(0) = 4;
        BUFFER(1) = 3;
        BUFFER(6) = 0;
        CALL ASCII$TO$FLOAT(, BUFFER, 7, RESULT);
        TEMP = CHECK$FP$VALUE(, RESULT, FP$100);
        END;
    END;
CALL SEND$CRLF;
OK = CHECK$INPUT;
CALL CLEAR$LOW$SCREEN;

```


COMMANDS

GET\$RANGE

END;
END GET\$RANGE;


```

/*****
*
* GET$DESIG:
* THIS PROCEDURE IS USED TO OBTAIN THE DESIGNATION OF THE CONTACT FROM
* THE CRT.
*
* USAGE:
* TYPED PROCEDURE. RETURNS A HASHED VALUE TO BE USED INTERNALLY ACCORDING
* TO THE FOLLOWING RULE:
*      HASH = CHAR*100 + CHAR1.
*
*****/
GET$DESIG: PROCEDURE ADDRESS PUBLIC;
    DCL HASH ADDRESS,
        BUFFER (2) BYTE,
        <CHAR, OK, CHAR1> BYTE;
    OK = 0;
    DO WHILE OK = 0;
        CALL CRT$PRINT$STRING(<'DESIG: '$>);
        L: CHAR = CRT$READ;
        DO WHILE (<CHAR < 41H> AND <CHAR <> 20H>) OR
            (<CHAR > 5AH> AND <CHAR < 61H>) OR <CHAR > 7AH>;
            CALL SEND$BEL;
            CHAR = CRT$READ;
        END;
        IF CHAR >= 61H THEN CHAR = CHAR - 20H;
        CALL CRT$WRITE(CHAR);
        CHAR1 = CRT$READ;
        DO WHILE (<CHAR1 < 41H> OR (<CHAR1 > 5AH> AND
            <CHAR1 < 61H>) OR <CHAR1 > 7AH>) AND <CHAR1 <> 07FH>;
            CALL SEND$BEL;

```



```

    CHAR1 = CRT$READ;
    END;
    IF CHAR1 = 07FH THEN DO;
        CALL SEND$BS;
        GO TO L;
    END;
    IF CHAR1 >= 61H THEN CHAR1 = CHAR1 - 20H;
    CALL CRT$WRITE(CHAR1);
    CALL SEND$CRLF;
    OK = CHECK$INPUT;
    CALL CLEAR$LOW$SCREEN;
    END;
    HASH = CHAR*100 + CHAR1;
    RETURN HASH;
END GET$DESIG;

```



```

/*****
*
* GET$TYPE:
* THIS PROCEDURE IS USED TO OBTAIN THE TYPE OF THE CONTACT FROM
* THE CRT.
*
* USAGE:
* TYPED PROCEDURE. RETURNS THE FOLLOWING VALUES :
* 0 ----> SURFACE.
* 1 ----> SUB-SURFACE.
*
*****/
GET$TYPE: PROCEDURE BYTE PUBLIC;
    DCL (TYPE, CHAR, OK) BYTE;
    OK = 0;
    DO WHILE OK = 0;
        CALL CRT$PRINT$STRING( ('IS IT A SURFACE TYPE CONTACT? (Y/N) $$$' ));
        CHAR = CHECK$YES$NO;
        CALL SEND$CRLF;
        CALL CRT$PRINT$STRING( ('TYPE: $$$' ));
        IF CHAR = 1
            THEN DO;
                CALL CRT$PRINT$STRING( ('SURFACE. $$$' ));
                TYPE = 0;
                END;
            ELSE DO;
                CALL CRT$PRINT$STRING( ('SUB-SURFACE. $$$' ));
                TYPE = 1;
                END;
            CALL SEND$CRLF;
            OK = CHECK$INPUT;
    END;

```


COMMANDS

GET\$TYPE

```
CALL CLEAR$LOW$SCREEN;  
END;  
RETURN TYPE;  
END GET$TYPE;
```



```

/*****
*
* GET$KIND:
* THIS PROCEDURE IS USED TO OBTAIN THE CONTACT CLASS FROM THE CRT.
*
* USAGE:
* TYPED PROCEDURE. RETURNS THE FOLLOWING VALUES:
* 0 ---> FRIEND.
* 1 ---> HOSTILE.
* 2 ---> UNKNOWN.
*
*****/
GET$KIND: PROCEDURE BYTE PUBLIC;
DCL (KIND, TEMP, CHAR, OK) BYTE;
OK = 0;
DO WHILE OK = 0;
TEMP = 0;
DO WHILE TEMP = 0;
CALL CRT$PRINT$STRING(, (ENTER THE CONTACT CLASS: (F/H/U) $$'));
CALL GET$STRING(, CHAR, 1);
IF (CHAR <> 'F') AND (CHAR <> 'H') AND (CHAR <> 'U')
THEN CALL PRINT$ERROR$MSG;
ELSE DO;
CALL CRT$WRITE(, (TEOL));
TEMP = 1;
IF CHAR = 'F'
THEN DO;
CALL CRT$PRINT$STRING(, (FRIEND, $$'));
KIND = 0;
END;
ELSE DO;

```



```

IF CHAR = 'H'
THEN DO;
  CALL CRT$PRINT$STRING( ('OSTILE. $$' ));
  KIND = 1;
  END;
ELSE DO;
  CALL CRT$PRINT$STRING( ('UNKNOWN. $$' ));
  KIND = 2;
  END;
END;

END;

END;
CALL SEND$CRLF;
OK = CHECK$INPUT;
CALL CLEAR$LOW$SCREEN;
END;
RETURN KIND;
END GET$KIND;

```



```

/*****
*
* GET$SCALE:
* THIS PROCEDURE IS USED TO OBTAIN A NUMBER REPRESENTING THE SCALE DESIRED
* TO BE USED IN THE PLOTTING AT THE PLASMA DISPLAY.
*
* PARAMETERS:
* - A - POINTER TO A MEMORY LOCATION IN WHICH THE FLOATING POINT REPRESENTATION OF THE SCALE (MILES/INCH) IS DESIRED TO BE PLACED.
*
*****/
GET$SCALE: PROCEDURE (A) PUBLIC;
DCL A ADDRESS,
      SCALE BASED A (4) BYTE,
      BUFFER (7) BYTE,
      (TEMP, TEMP1, OK) BYTE;

      OK = 0;
DO WHILE OK = 0;
  CALL CRT$PRINT$STRING(, (ENTER THE SCALE AS REQUESTED:$$'));
  CALL SEND$CRLF;
  TEMP, TEMP1 = 0;
  DO WHILE (TEMP = 0) OR (TEMP1 = 0);
    CALL CRT$PRINT$STRING(, (MILES PER INCH: $$'));
    CALL PUT$NUMBER$BUFFER(2, BUFFER(2));
    CALL CRT$WRITE(POINT);
    CALL PUT$NUMBER$BUFFER(2, BUFFER(4));
    BUFFER(0) = 4;
    BUFFER(1) = 2;
    BUFFER(6) = 0;
    CALL ASCII$TO$FLOAT(, BUFFER, 7, SCALE);
    TEMP = CHECK$FP$VALUE(, SCALE, FP$25);
  
```


COMMANDS

GET\$SCALE

```
IF TEMP <> 0 THEN
  TEMP1 = CHECK$FP$VALUE(.FP$0$25.,.SCALE);
  END;
  CALL SEND$CRLF;
  OK = CHECK$INPUT;
  CALL CLEAR$LOW$SCREEN;
  END;
  END GET$SCALE;

END COMMANDS;
```



```
PLASMA$MODULE: DO;
```

```
$NOLIST
```

```
$INCLUDE (:F1:EXTER.SRC)
```

```
$INCLUDE (:F1:EXTER1.SRC)
```

```
$INCLUDE (:F1:EXTER2.SRC)
```

```
$LIST
```



```

/****  DECLARATIONS:  ****/

DCL TRUE LIT '0FFH',
FALSE LIT '00H',
EOL LIT '024H',
POINT LIT '02EH';

DCL FP#2  (4) BYTE DATA (000H, 000H, 000H, 040H), /* 2.0 */
FP#8  (4) BYTE DATA (0CDH, 0CCH, 008H, 041H), /* 8.55 */
FP#511 (4) BYTE DATA (000H, 080H, 0FFH, 043H); /* 511.0 */

DCL LAST$POSI (15) STRUCTURE(
    FLAG BYTE,
    X ADDRESS,
    Y ADDRESS),

    OS$LAST$POSI STRUCTURE(
    FLAG BYTE,
    X ADDRESS,
    Y ADDRESS);

DCL WINDOW (4) BYTE,
    HALF$WINDOW (4) BYTE,
    ORIGIN#X (4) BYTE,
    ORIGIN#Y (4) BYTE;

```


DCL BUFFER (*) BYTE INITIAL ('SCALE: 0)


```
/******  
* * SET$WINDOW:  
* * THIS PROCEDURE IS USED TO FIND THE VALUES OF THE WINDOW AND HALF$WINDOW  
* * FLOATING POINT VECTORS.  
* *  
*****/  
SET$WINDOW: PROCEDURE PUBLIC;  
  CALL FMUL(.SYSTEM.SCALE, .FP$8, .WINDOW);  
  CALL FDIV(.WINDOW, .FP$2, .HALF$WINDOW);  
  END SET$WINDOW;
```



```
/******  
* CLEAR$STRUCTURES:  
* THIS PROCEDURE IS USED TO CLEAR THE STRUCTURES USED IN THIS MODULE.  
*  
*****  
CLEAR$STRUCTURES:: PROCEDURE PUBLIC;  
  DCL A ADDRESS,  
        VALUE BASED A BYTE,  
        I BYTE;  
  A = .LAST$POSI;  
  DO I = 0 TO 74;  
    VALUE = 00H;  
    A = A + 1;  
  END;  
  A = .OS$LAST$POSI;  
  DO I = 0 TO 4;  
    VALUE = 00H;  
    A = A + 1;  
  END;  
END CLEAR$STRUCTURES;
```



```

/*****
*
* DRAW$FRIENDLY$SYMBOL:
* THIS PROCEDURE IS USED TO DRAW IN THE PLASMA DISPLAY, IN A GIVEN POSITION,
* THE SYMBOL USED TO REPRESENT A FRIENDLY CONTACT.
*
* PARAMETERS:
* - X. - ADDRESS VALUE.
* - Y. - ADDRESS VALUE.
*
*****/
DRAW$FRIENDLY$SYMBOL: PROCEDURE (X, Y) PUBLIC;
  DCL (X, Y) ADDRESS,
    (TEMP%X, TEMP$Y) ADDRESS;
  IF (X < 2) OR (X > 509) OR (Y < 2) OR (Y > 509)
  THEN RETURN; /* SYMBOL CAN NOT BE DRAWN */
  TEMP%X = X - 1;
  TEMP$Y = Y + 2;
  CALL START$VECTOR$SOLID(TEMP%X, TEMP$Y);
  TEMP%X = X + 1;
  CALL STOP$VECTOR$SOLID(TEMP%X, TEMP$Y);
  TEMP%X = X + 2;
  TEMP$Y = Y + 1;
  CALL START$VECTOR$SOLID(TEMP%X, TEMP$Y);
  TEMP$Y = Y - 1;
  CALL STOP$VECTOR$SOLID(TEMP%X, TEMP$Y);
  TEMP%X = X + 1;
  TEMP$Y = Y - 2;
  CALL START$VECTOR$SOLID(TEMP%X, TEMP$Y);
  TEMP%X = X - 1;
  CALL STOP$VECTOR$SOLID(TEMP%X, TEMP$Y);

```



```
TEMP$X = X - 2;  
TEMP$Y = Y - 1;  
CALL START$VECTOR$SOLID(TEMP$X, TEMP$Y);  
TEMP$Y = Y + 1;  
CALL STOP$VECTOR$SOLID(TEMP$X, TEMP$Y);  
END DRAW$FRIENDLY$SYMBOL;
```



```

/*****
*
* DRAW$UNK$HOS$SYMBOL:
* THIS PROCEDURE IS USED TO DRAW IN THE PLASMA DISPLAY, IN A GIVEN POINT,
* THE SYMBOL USED TO REPRESENT UNKNOWN AND/OR HOSTILE CONTACTS.
*
* PARAMETERS:
* - X. - ADDRESS VALUE.
* - Y. - ADDRESS VALUE.
*
*****/
DRAW$UNK$HOS$SYMBOL: PROCEDURE (X, Y) PUBLIC
DECL (X, Y, TEMP%X, TEMP$Y) ADDRESS;
IF (X < 2) OR (X > 509) OR (Y < 2) OR (Y > 509)
THEN RETURN; /* SYMBOL CAN NOT BE DRAWN */
TEMP%X = X - 2;
TEMP$Y = Y - 2;
CALL START$VECTOR$SOLID(TEMP%X, TEMP$Y);
TEMP%X = X + 2;
TEMP$Y = Y + 2;
CALL STOP$VECTOR$SOLID(TEMP%X, TEMP$Y);
TEMP%X = X - 2;
CALL START$VECTOR$SOLID(TEMP%X, TEMP$Y);
TEMP%X = X + 2;
TEMP$Y = Y - 2;
CALL STOP$VECTOR$SOLID(TEMP%X, TEMP$Y);
END DRAW$UNK$HOS$SYMBOL;

```



```

/*****
*
* DRAW$OWN$SHIP$SYMBOL:
* THIS PROCEDURE IS USED TO DRAW IN THE PLASMA DISPLAY, IN A GIVEN POINT,
* THE SYMBOL USED TO REPRESENT THE OWN SHIP.
*
* PARAMETERS:
* - X. - ADDRESS VALUE.
* - Y. - ADDRESS VALUE.
*
*****/
DRAW$OWN$SYMBOL: PROCEDURE (X, Y) PUBLIC;
DCL (X, Y, TEMP%X, TEMP$Y) ADDRESS;
CALL DRAW$FRIENDLY$SYMBOL(X, Y);
IF (X = 0) OR (X = 511) OR (Y = 0) OR (Y = 511)
  THEN RETURN; /* SYMBOL CAN NOT BE DRAWN. */
TEMP%X = X - 1;
TEMP$Y = Y + 1;
CALL START$VECTOR$SOLID(TEMP%X, TEMP$Y);
TEMP%X = X + 1;
CALL STOP$VECTOR$SOLID(TEMP%X, TEMP$Y);
CALL START$VECTOR$SOLID(TEMP%X, TEMP$Y);
TEMP$Y = Y - 1;
CALL STOP$VECTOR$SOLID(TEMP%X, TEMP$Y);
CALL START$VECTOR$SOLID(TEMP%X, TEMP$Y);
TEMP%X = X - 1;
CALL STOP$VECTOR$SOLID(TEMP%X, TEMP$Y);
CALL START$VECTOR$SOLID(TEMP%X, TEMP$Y);
TEMP$Y = Y + 1;
CALL STOP$VECTOR$SOLID(TEMP%X, TEMP$Y);
END DRAW$OWN$SHIP$SYMBOL;

```



```

/*****
*
* CHECK$PLASMA:
* THIS PROCEDURE IS USED TO DETERMINE WHETHER OR NOT A POINT REPRESENTED
* BY TWO X,Y RP VALUES, CAN BE DISPLAYED AT THE PLASMA.
*
* PARAMETERS:
* - A. - POINTER TO A FOUR BYTE VECTOR REPRESENTING THE X VALUE;
* - B. - POINTER TO A FOUR BYTE VECTOR REPRESENTING THE Y VALUE.
*
* USAGE:
* TYPED PROCEDURE. RETURNS A VALUE OF 'TRUE' (OFFH) IF THE POINT CAN BE
* DISPLAYED AT THE CURRENT SCALE; OTHERWISE, A VALUE OF 'FALSE' (OOH)
* IS RETURNED.
*
*****/
CHECK$PLASMA: PROCEDURE (A, B) BYTE PUBLIC;
  DCL (A, B) ADDRESS,
       X BASED A (4) BYTE,
       Y BASED B (4) BYTE,
       TEMP (4) BYTE;
  CHECK BYTE DATA (OOH);
  CALL FADD(.ORIGIN$, .WINDOW, .TEMP);
  IF FCMPR(.X, .TEMP, .CHECK)
  THEN RETURN FALSE;
  IF FCMPR(.ORIGIN$, .X, .CHECK)
  THEN RETURN FALSE;
  CALL FSUB(.ORIGIN$, .WINDOW, .TEMP);
  IF FCMPR(.Y, .ORIGIN$, .CHECK)
  THEN RETURN FALSE;
  IF FCMPR(.TEMP, .Y, .CHECK)

```



```
    THEN RETURN FALSE;
/*  EVERYTHING IS OKAY.  RETURN A TRUE VALUE  */
RETURN TRUE;
END CHECK$PLASMA;
```



```

/*****
*
* NORMALIZE:
* THIS PROCEDURE IS USED TO NORMALIZE TWO FP VALUES INTO ADDRESS VALUES
* THAT CAN BE USED TO DETERMINE A POINT IN THE PLASMA DISPLAY. IT MUST
* BE USED AFTER 'CHECK$PLASMA'.
*
* PARAMETERS:
* - A - POINTER TO A FOUR BYTE VECTOR REPRESENTING A FP 'X' VALUE.
* - B - POINTER TO A FOUR BYTE VECTOR REPRESENTING A FP 'Y' VALUE.
* - C - POINTER TO AN ADDRESS VALUE IN WHICH THE 'NORMALIZED X' IS
* DESIRED TO BE PLACED.
* - D - POINTER TO AN ADDRESS VALUE IN WHICH THE 'NORMALIZED Y' IS
* DESIRED TO BE PLACED.
*
*****/
NORMALIZE: PROCEDURE (A, B, C, D) PUBLIC;
    DCL (A, B, C, D) ADDRESS,
        FP$X BASED A (4) BYTE,
        FP$Y BASED B (4) BYTE,
        X BASED C ADDRESS,
        Y BASED D ADDRESS,
        DELTA$X (4) BYTE,
        DELTA$Y (4) BYTE,
        TEMP (4) BYTE,
        TEMP1 (4) BYTE;
    CALL FSUBC, FP$X, .ORIGIN$X, .DELTA$X);
    IF DELTA$X(3) >= 80H
    THEN DELTA$X(3) = DELTA$X(3) XOR 080H; /* ABSOLUTE VALUE REQUIRED */
    CALL FSUBC, ORIGIN$Y, .FP$Y, .DELTA$Y);
    IF DELTA$Y(3) >= 80H

```



```
      THEN DELTA#Y(3) = DELTA#Y(3) XOR 880H; /* ABSOLUTE VALUE REQUIRED */
      CALL FDIY(.FP#51L, .WINDOW, .TEMP);
      CALL FMUL(.TEMP, .DELTA#X, .TEMP1);
      CALL FIXSD(.TEMP1, .TEMP1);
      X = TEMP1(1);
      X = SHL(X, 8) + TEMP1(0);
      CALL FMUL(.TEMP, .DELTA#Y, .TEMP1);
      CALL FIXSD(.TEMP1, .TEMP1);
      Y = TEMP1(1);
      Y = SHL(Y, 8) + TEMP1(0);
      END NORMALIZE;
```



```

/*****
*
* PUT$OS$CENTER:
*   THIS PROCEDURE IS USED TO CHANGE THE X/Y VALUES USED IN THE PLASMA ORI-
*   GIN, IN ORDER TO ALLOW THE OWN SHIP'S LAST POSITION TO BE IN THE NEW
*   PLASMA DISPLAY CENTER.
*
*****/
PUT$OS$CENTER: PROCEDURE PUBLIC;
    DCL POINTER BYTE;
    POINTER = OWN$SHIP$INFO.POINTER;
    CALL FSUBC.OWN$SHIP(POINTER),X, HALF$WINDOW, ORIGIN$X;
    CALL FADDC.OWN$SHIP(POINTER),Y, HALF$WINDOW, ORIGIN$Y;
    END PUT$OS$CENTER;

```



```

/*****
*
* PUT$CONTACT$CENTER:
*   THIS PROCEDURE IS USED TO CHANGE THE X/Y VALUES USED IN THE PLASMA ORI-
*   GIN. IN ORDER TO ALLOW THE GIVEN CONTACT/LAST POSITION TO BE IN THE NEW
*   PLASMA DISPLAY CENTER.
*
* PARAMETERS:
*   - INDEX - INDICATES THE RELATIVE POSITION OF THE CONTACT IN THE CONTACT$-
*   INFO STRUCTURE.
*
*****/
PUT$CONTACT$CENTER: PROCEDURE (INDEX) PUBLIC
  DECL (POINTER, INDEX) BYTE
  POINTER = CONTACT$INFO(INDEX).POINTER
  CALL FSUBC( CONTACT$POSI(POINTER).X, HALF$WINDOW, ORIGIN$X)
  CALL FADDC( CONTACT$POSI(POINTER).Y, HALF$WINDOW, ORIGIN$Y)
  END PUT$CONTACT$CENTER

```


PLASMA\$MODULE FIXED\$REORIENTATION

```

/******
*
* FIXED$REORIENTATION:
* THIS PROCEDURE IS USED TO DEFINE A NEW REFERENCE POINT FOR THE PLASMA
* DISPLAY, ACCORDING TO 8 PREDEFINED POINTS.
*
* PARAMETERS:
* - TYPE - BYTE NUMBER BETWEEN 0 AND 7 THAT IS USED TO IDENTIFY THE 8 PRE-
* DEFINED WAYS TO REORIENT THE PLASMA SCREEN.
*
*****
FIXED$REORIENTATION: PROCEDURE (TYPE) PUBLIC;
DECL TYPE BYTE;
DO CASE TYPE;
DO; /* CASE 0 */
CALL FADD(.ORIGIN$Y, .HALF$WINDOW, .ORIGIN$Y);
END;

DO; /* CASE 1 */
CALL FADD(.ORIGIN%X, .HALF$WINDOW, .ORIGIN%X);
CALL FADD(.ORIGIN$Y, .HALF$WINDOW, .ORIGIN$Y);
END;

DO; /* CASE 2 */
CALL FADD(.ORIGIN%X, .HALF$WINDOW, .ORIGIN%X);
END;

DO; /* CASE 3 */
CALL FADD(.ORIGIN%X, .HALF$WINDOW, .ORIGIN%X);
CALL FADD(.ORIGIN$Y, .HALF$WINDOW, .ORIGIN$Y);
END;

```



```
DO; /* CASE 4 */
  CALL FSUB(.ORIGIN$Y, .HALF$WINDOW, .ORIGIN$Y);
END;

DO; /* CASE 5 */
  CALL FSUB(.ORIGIN$X, .HALF$WINDOW, .ORIGIN$X);
  CALL FSUB(.ORIGIN$Y, .HALF$WINDOW, .ORIGIN$Y);
END;

DO; /* CASE 6 */
  CALL FSUB(.ORIGIN$X, .HALF$WINDOW, .ORIGIN$X);
END;

DO; /* CASE 7 */
  CALL FSUB(.ORIGIN$X, .HALF$WINDOW, .ORIGIN$X);
  CALL FADD(.ORIGIN$Y, .HALF$WINDOW, .ORIGIN$Y);
END;

END; /* END CASE */
END FIXED$REORIENTATION;
```



```

/*****
*
* PLASMA#REDESIG:
* THIS PROCEDURE IS USED TO DISPLAY, IF POSSIBLE, THE NEW CONTACT'S DESIG
* IN THE LAST KNOWN POSITION.
*
* PARAMETERS:
* - INDEX - INDICATES THE RELATIVE POSITION OF THE CONTACT IN THE CONTACT#-
* INFO STRUCTURE.
*
*****/
PLASMA#REDESIG: PROCEDURE (INDEX) PUBLIC;
  DCL (X, Y) ADDRESS,
        INDEX BYTE;
  IF LAST#POSI<INDEX>.FLAG
  THEN DO:
    X = LAST#POSI<INDEX>.X;
    Y = LAST#POSI<INDEX>.Y;
    CALL GRAPHIC#DESIG(X, Y, CONTACT#INFO<INDEX>.DESIG);
  END;
END PLASMA#REDESIG;

```



```

/*****
*
* PLASMA$DELETE:
* THISPROCEDURE IS USED TO CLEAR THE FLAG CORRESPONDING TO A CONTACT THAT
* HAS BEEN REMOVED FROM THE SYSTEM.
*
* PARAMETERS:
* - INDEX. - INDICATES THE RELATIVE POSITION OF THE CONTACT IN THE CONTACT$-
* INFO STRUCTURE.
*
*****/
PLASMA$DELETE: PROCEDURE (INDEX) PUBLIC;
    DCL INDEX BYTE;
    LAST$POS1(INDEX).FLAG = FALSE;
    END PLASMA$DELETE;

```



```

/*****
*
* PLASMA$CONTACT:
* THIS PROCEDURE IS USED TO TRY TO PLOT THE LAST POSITION OF A GIVEN CONTACT, IF POSSIBLE.
*
* PARAMETERS:
* - INDEX - INDICATES THE RELATIVE POSITION OF THE CONTACT IN THE CONTACT$-INFO STRUCTURE.
*
*****/
PLASMA$CONTACT: PROCEDURE (INDEX) PUBLIC;
  DCL (X, Y) ADDRESS,
        (POINTER, INDEX, TEMP) BYTE;
  POINTER = CONTACT$INFO(INDEX).POINTER;
  TEMP = CHECK$PLASMA<, CONTACT$POSI(POINTER), X, CONTACT$POSI(POINTER), Y>;
  IF LAST$POSI(INDEX).FLAG
  THEN DO;
    IF TEMP
    THEN DO;
      CALL START$VECTOR$DASH<LAST$POSI(INDEX), X, LAST$POSI(INDEX), Y>;
      CALL NORMALIZE<, CONTACT$POSI(POINTER), X, CONTACT$POSI(POINTER), Y, X, Y>;
      CALL STOP$VECTOR$DASH<X, Y>;
      IF CONTACT$INFO(INDEX).KIND = 0
      THEN CALL DRAW$FRIENDLY$SYMBOL<X, Y>;
      ELSE CALL DRAW$UNK$HOS$SYMBOL<X, Y>;
      LAST$POSI(INDEX).X = X;
      LAST$POSI(INDEX).Y = Y;
    END;
  ELSE DO;

```



```
        LAST$POSI<INDEX>.FLAG = FALSE;
    END;

    ELSE DO;
        IF TEMP
        THEN DO;
            CALL NORMALIZE(.CONTACT$POSI<POINTER>.% .CONTACT$POSI<POINTER>.%
                .X% .Y%);
            CALL GRAPHIC$DESIG(X% Y% .CONTACT$INFO<INDEX>.DESIG);
            IF CONTACT$INFO<INDEX>.KIND = 0
            THEN CALL DRAW$FRIENDLY$SYMBOL(X% Y%);
            ELSE CALL DRAW$UNK$HOS$SYMBOL(X% Y%);
            LAST$POSI<INDEX>.FLAG = TRUE;
            LAST$POSI<INDEX>.X = X;
            LAST$POSI<INDEX>.Y = Y;
        END;
    END;

END PLASMA$CONTACT;
```



```

/*****
*
* PLASMA$POS:
*   THIS PROCEDURE IS USED TO DISPLAY, IF POSSIBLE, THE LAST KNOWN POSITION
*   OF THE OWN SHIP IN THE PLASMA DISPLAY.
*
*****/
PLASMA$POS: PROCEDURE PUBLIC;
    DCL (X, Y) ADDRESS,
        (POINTER, TEMP) BYTE;
    POINTER = OWN$SHIP$INFO.POINTER;
    TEMP = CHECK$PLASMA(, OWN$SHIP(POINTER), X, , OWN$SHIP(POINTER), Y);
    IF OS$LAST$POS1.FLAG
    THEN DO;
        IF TEMP
        THEN DO;
            CALL START$VECTOR$SOLID(OS$LAST$POS1.X, OS$LAST$POS1.Y);
            CALL NORMALIZE(, OWN$SHIP(POINTER), X, , OWN$SHIP(POINTER), Y,
                          , X, , Y);
            CALL STOP$VECTOR$SOLID(X, Y);
            CALL DRAW$OWN$SHIP$SYMBOL(X, Y);
            OS$LAST$POS1.X = X;
            OS$LAST$POS1.Y = Y;
        END;
    ELSE DO;
        OS$LAST$POS1.FLAG = FALSE;
    END;
END;
ELSE DO;
    IF TEMP
    THEN DO;

```



```
CALL NORMALIZE(OWN$SHIP(POINTER).X, OWN$SHIP(POINTER).Y,  
              .X, .Y);  
CALL DRAW$OWN$SHIP$SYMBOL(X, Y);  
OS$LAST$POS1.FLAG = TRUE;  
OS$LAST$POS1.X = X;  
OS$LAST$POS1.Y = Y;  
END;  
END;  
END PLASMA$OS;
```



```

/*****
*
* DRAW$EVERYTHING:
* THIS PROCEDURE IS USED TO REDRAW THE ENTIRE DISPLAY.
*
*****/
DRAW$EVERYTHING: PROCEDURE PUBLIC;
DECL (POINTER, I, J, P, TEMP) BYTE;
CALL CLEAR$PLASMA;
POINTER = OWN$SHIP$INFO.POINTER;
IF OWN$SHIP$INFO.FLAG
THEN DO;
  P = POINTER + 1;
  DO I = 0 TO 29;
    IF P >= 30 THEN P = 0;
    OWN$SHIP$INFO.POINTER = P;
    CALL PLASMA$OS;
    P = P + 1;
  END;
END;
ELSE DO;
  DO I = 0 TO POINTER;
    OWN$SHIP$INFO.POINTER = I;
    CALL PLASMA$OS;
  END;
END;
OWN$SHIP$INFO.POINTER = POINTER;
DO I = 0 TO 14;
  IF CONTACT$INFO(I).DESIG <> 00H
  THEN DO;
    POINTER = CONTACT$INFO(I).POINTER;

```



```
TEMP = CONTACT$INFO(I). POINTER / 15;
TEMP = (TEMP + 1) * 15;
IF CONTACT$INFO(I). FLAG
THEN DO;
  P = POINTER + 1;
  DO J = 0 TO 14;
    IF P >= TEMP THEN P = (POINTER / 15) * 15;
    CONTACT$INFO(I). POINTER = P;
    CALL PLASMA#CONTACT(I);
    P = P + 1;
  END;
END;
ELSE DO;
  DO J = ((POINTER / 15) * 15) TO POINTER;
    CONTACT$INFO(I). POINTER = J;
    CALL PLASMA#CONTACT(I);
  END;
END;
CONTACT$INFO(I). POINTER = POINTER;
END;
END DRAW#EVERYTHING;
```



```
/******  
*  
* DISPLAY$PLASMA$SCALE:  
* THIS PROCEDURE IS USED TO DISPLAY AT THE PLASMA DISPLAY, THE SCALE BEING  
* USED TO DRAW THE PICTURE.  
*  
*****/  
DISPLAY$PLASMA$SCALE: PROCEDURE PUBLIC;  
  DCL TEMP BYTE;  
  TEMP = FP$FORMAT(.SYSTEM.SCALE, .BUFFER(7), 2, 2);  
  BUFFER(12), BUFFER(13) = EOL;  
  BUFFER(11) = BUFFER(10);  
  BUFFER(10) = BUFFER(9);  
  BUFFER(9) = POINT;  
  CALL PLASMA$PRINT$STRING(0, 2, .BUFFER);  
END DISPLAY$PLASMA$SCALE;
```



```

/*****
*
* REORIENT$PS:
*   THIS PROCEDURE IS USED TO DEFINE A NEW REFERENCE POINT FOR THE PICTURE
*   TO BE PRESENTED AT THE PLASMA DISPLAY.
*
*****/
REORIENT$PS: PROCEDURE PUBLIC;
  DCL DESIG ADDRESS,
    <TYPE, OK, REORIENT, INDEX, TEMP, FLAG, COUNT> BYTE;
  DCL TITLE <*> BYTE DATA
    (',',
      MSG0 <*> BYTE DATA
        ('IF FIXED REORIENTATION IS DESIRED, TYPE 0. $$'),
      MSG1 <*> BYTE DATA
        ('IF OWN SHIP AT CENTER IS DESIRED, TYPE 1. $$'),
      MSG2 <*> BYTE DATA
        ('IF A CONTACT IS DESIRED AT CENTER, TYPE 2. $$'),
      MSG3 <*> BYTE DATA
        ('ENTER VALUE: $$'),
      MSG4 <*> BYTE DATA
        ('ENTER POINT DESIRED TO BE AT CENTER: $$'),
      MSG5 <*> BYTE DATA
        ('ENTER CONTACT DESIG AS REQUESTED: $$'),
      MSG6 <*> BYTE DATA
        ('DESIG NOT IN USE. $$');
  IF SYSTEM.NUMCTS > 0
  THEN DO;
    FLAG = TRUE;
    COUNT = '2';
    PICTURE REORIENTATION. $$');

```



```
END;
ELSE DO;
  FLAG = FALSE;
  COUNT = '1';
  END;
CALL CLEAR$STRUCTURES;
CALL SET$WINDOW;
OK = 0;
DO WHILE OK = 0;
  CALL CRT$PRINT$STRING(.TITLE);
  CALL SEND$CRLF;
  CALL CRT$PRINT$STRING(.MSG0);
  CALL SEND$CRLF;
  CALL CRT$PRINT$STRING(.MSG1);
  CALL SEND$CRLF;
  IF FLAG
  THEN DO;
    CALL CRT$PRINT$STRING(.MSG2);
    CALL SEND$CRLF;
  END;
  CALL CRT$PRINT$STRING(.MSG3);
  REORIENT = CRT$READ;
  DO WHILE (REORIENT < '0') OR (REORIENT > COUNT);
    CALL SEND$BEL;
    REORIENT = CRT$READ;
  END;
  CALL CRT$WRITE(REORIENT);
  CALL SEND$CRLF;
  OK = CHECK$INPUT;
  CALL CLEAR$LOW$SCREEN;
END;
```



```

REORIENT = REORIENT - 30H;
DO CASE REORIENT;

  DO; /* CASE 0. FIXED REORIENTATION. */
    OK = 0;
    DO WHILE OK = 0;
      CALL CRT$PRINT$STRING(.TITLE);
      CALL SEND$CRLF;
      CALL CRT$PRINT$STRING(.MSG4);
      TYPE = CRT$READ;
      DO WHILE (TYPE < '0') OR (TYPE > '7');
        CALL SEND$BEL;
        TYPE = CRT$READ;
      END;
      CALL CRT$WRITE(TYPE);
      CALL SEND$CRLF;
      OK = CHECK$INPUT;
      CALL CLEAR$LOW$SCREEN;
    END;
    CALL FIXED$REORIENTATION(TYPE - 30H);
  END;
  DO; /* CASE 1. OWN SHIP AT CENTER. */
    CALL PUT$OS$CENTER;
  END;
  DO; /* CASE 2. CONTACT AT CENTER. */
    OK = 0FFH;
    DO WHILE 'OK' = 0FFH;
      CALL CRT$PRINT$STRING(.TITLE);
      CALL SEND$CRLF;
      CALL CRT$PRINT$STRING(.MSG5);
      CALL SEND$CRLF;
    END;
  END;

```



```
DESIG = GET$DESIG;
INDEX = CHECK$DESIG(DESIG);
IF INDEX = 0FFH
THEN DO;
    CALL CRT$PRINT$STRING(. MSGS);
    CALL SEND$CRLF;
    CALL SEND$CRLF;
    CALL CHECK$GO$KEY;
    END;
    OK = INDEX;
    CALL CLEAR$LOW$SCREEN;
    END;
    CALL PUT$CONTACT$CENTER(INDEX);
    END;
    END; /* END CASE */

    CALL DRAW$EVERYTHING;
    CALL DISPLAY$PLASMA$SCALE;
    END REORIENT$PS;

END PLASMA$MODULE;
```


CRT: DO;

```
CRT$WRITE:
  PROCEDURE (A) EXTERNAL;
  DECLARE A BYTE; END;
```

```
CRT$PRINT$STRING:
  PROCEDURE (A) EXTERNAL;
  DECLARE A ADDRESS; END;
```

```
DECLARE
  LIT LITERALLY 'LITERALLY',
  DCL LIT 'DECLARE';
```

```
DCL LF LIT '0AH',
  MASTER$CLEAR LIT '1EH',
  BLINK LIT '0EH',
  ETEOL LIT '17H',
  EOL LIT '24H',
  HOME LIT '02H',
  TAB LIT '09H',
  FS LIT '1CH',
  PROT$FIELD LIT '0FH',
  END$PF LIT '18H',
  SPACE LIT '20H';

/* LINE FEED. */
/* MASTER CLEAR. */
/* BLINK ON. */
/* ERASE TO END OF LINE. */
/* END OF LINE. */
/* HOME. */
/* TAB. */
/* FORWARD CURSOR. NON-DESTRUCTIVE. */
/* START PROTECTED FIELD. */
/* STOP PROTECTED FIELD. */
/* SPACE. */
```

```
DCL LIN1 (*) BYTE DATA
  ('TIME: (#3) %5%4%5%4LAST MARK%4%5%5%6C P A%7#');
```



```

LIN2A (*) BYTE DATA
      ('$2:$2:$2%4\DESIG\TYPE\CLASS\ TIME\ BRG \ RNG \#'),
LIN2B (*) BYTE DATA
      ('COURSE\SPEED\ TIME\ BRG \ RNG #'),
LIN3A (*) BYTE DATA
      ('%<#'),
LIN4A (*) BYTE DATA
      ('LAT:%8#'),
LIN5A (*) BYTE DATA
      ('$3:$2:$1 $1 #'),
LIN6A (*) BYTE DATA
      ('LONG:%7#'),
LIN9A (*) BYTE DATA
      ('COURSE:$3.$1#'),
LIN10A (*) BYTE DATA
      ('SPEED: $2.$1#'),
LIN12A (*) BYTE DATA
      ('CONTACTS: #'),
LIN13A (*) BYTE DATA
      (' $2F $2H $2U#'),
LIN15A (*) BYTE DATA
      ('MODE:$7#'),
LIN16 (*) BYTE DATA
      ('%XX#'),
LINF (*) BYTE DATA
      ('%5\%4\%5\%5\%6\%6\%5\%5\%5\%6#'),
LINE (*) BYTE DATA
      ('\ $2 \ $2 \ $3 \ $2:$2:$3. $1\ $5\ $3. $1\ $2:$2:$3. $1\ $5#');

```


CRT

CRT\$MASTER\$CLEAR;

```
/******  
* CRT$MASTER$CLEAR:  
*   THIS PROCEDURE WILL CLEAR THE ENTIRE SCREEN, AND PUT THE CURSOR AT HOME.  
*  
*****  
CRT$MASTER$CLEAR: PROCEDURE PUBLIC;  
    C:1 : "ILL CRT$WRITE(MASTER$CLEAR);  
        END CRT$MASTER$CLEAR;
```


CRT

SET\$LOW\$HOME

```

/*****
*
* SET$LOW$HOME:
*   THIS PROCEDURE WILL LOCATE THE CURSOR AT THE FIRST COLUMN IN ROW 17.
*
*****/
SET$LOW$HOME: PROCEDURE PUBLIC;
    DCL I BYTE;
    CALL CRT$WRITE(HOME);
    DO I = 1 TO 8;
        CALL CRT$WRITE(LF);
    END;
END SET$LOW$HOME;
```



```
/******
*
* CLEAR$LOW$SCREEN:
* THIS PROCEDURE WILL CLEAR ROWS 17 THRU 24.
* AFTER THIS OPERATION, THE CURSOR WILL BE PLACED AT COLUMN 1 IN
* ROW 17.
*
*****
*
CLEAR$LOW$SCREEN: PROCEDURE PUBLIC;
    DCL I BYTE;
    CALL SET$LOW$HOME;
    CALL CRT$WRITE(ETEOL);
    DO I = 1 TO 7;
        CALL CRT$WRITE(LF);
        CALL CRT$WRITE(ETEOL);
    END;
    CALL SET$LOW$HOME;
    END CLEAR$LOW$SCREEN;
```



```
/******  
* SET$HIGH$HOME:  
* THIS PROCEDURE WILL LOCATE THE CURSOR AT THE COLUMN 1 AT ROW 1.  
*  
*****/  
SET$HIGH$HOME: PROCEDURE PUBLIC;  
  CALL CRT$WRITE$HOME;  
  END SET$HIGH$HOME;
```



```

/*****
*
*   THIS PROCEDURE WILL WRITE A CERTAIN NUMBER OF SPACES AT THE CRT.
*
*   *
*   *   PARAMETERS:
*   *   - NUM. - NUMBER OF SPACES TO BE WRITTEN.
*
*****/
PUT$SPACE: PROCEDURE(NUM);
DCL NUM BYTE;
DO WHILE NUM > 0;
  CALL CRT$WRITE(SPACE);
  NUM = NUM - 1;
END;
END PUT$SPACE;
/
```



```

/***** **/
*
*      * PUT$TAB:
*      THIS PROCEDURE WILL SEND A GIVEN NUMBER OF 'TABS' TO THE CRT.
*
*      * PARAMETERS:
*      *      - NUM. - NUMBER OF TABS DESIRED.
*
*****/
PUT$TAB: PROCEDURE(NUM);
    DCL NUM BYTE;
    DO WHILE NUM > 0;
        CALL CRT$WRITE(TAB);
        NUM = NUM - 1;
    END;
END PUT$TAB;

```


CRT

PUT\$FS

```

/*****
*
* PUT$FS:
*   THIS PROCEDURE WILL SEND TO THE CRT A GIVEN NUMBER OF NON-DESTRUCTIVE
*   FORWARD CURSOR CHARACTERS.
*
* PARAMETERS:
*   - NUM. - NUMBER OF NON-DESTRUCTIVE FORWARD CURSOR CHARACTERS DESIRED.
*
*****/
PUT$FS: 1 PROCEDURE (NUM);
        DCL INL IN BYTE;
        DO WHILE NUM > 0;
            CALL CRT$WRITE(FS);
            NUM = NUM - 1;
        END;
END PUT$FS;

```



```

/*****
*
* PUT$LF:
* THIS PROCEDURE WILL SEND AN SPECIFIED NUMBER OF LINE FEED CHARACTERS
* TO THE CRT.
*
* - NUM. - NUMBER OF LINE FEED CHARACTERS DESIRED.
*
*****
PUT$LF: PROCEDURE(NUM);
    DCL NUM BYTE;
    DO WHILE NUM > 0;
        CALL CRT$WRITE(LF);
        NUM = NUM - 1;
    END;
END PUT$LF;
*****/
```


CRT

START\$PROT\$FIELD

```
/******  
* * START$PROT$FIELD:  
* * THIS PROCEDURE WILL CAUSE ALL CHARACTERS SENT AFTER IT FINISHES, TO  
* * BE IN A PROTECTED FIELD.  
* *  
*****/  
START$PROT$FIELD: PROCEDURE;  
  CALL CRT$WRITE(PROT$FIELD);  
  END START$PROT$FIELD;
```


CRT

START\$BLINK

```
/******  
*  
* START$BLINK:  
* THIS PROCEDURE WILL CAUSE ALL CHARACTERS SENT AFTER IT TO BLINK.  
*  
*****/  
START$BLINK: PROCEDURE PUBLIC;  
  CALL CRT$WRITE(BLINK);  
  END START$BLINK;
```


CRT

STOP\$PROT\$FIELD

```

/*****
*
* STOP$PROT$FIELD:
* THIS PROCEDURE WILL CAUSE THE END TO 'INSERT PROTECTED FIELD',
* 'ROLL MODE' AND 'BLINK ON'.
*
*****/
STOP$PROT$FIELD: PROCEDURE;
  CALL CRT$WRITE(END$PF);
  END STOP$PROT$FIELD;
```



```

/*****
*
* INTERP:
*   THIS PROCEDURE IS USED BY 'INIT$HIGH$SCREEN' TO INTERPRET THE
*   STREAM OF CHARACTERS USED TO INITIALIZE THE HIGH PORTION OF THE
*   SCREEN. (ROWS 1 THRU 16)
*
* PARAMETERS:
*   - A - POINTER TO THE FIRST LOCATION OF A STRING OF CONTROL CHARACTERS
*   USED TO FORMAT THE ROWS ON THE HIGH PORTION OF THE SCREEN.
*
*****/
INTERP: PROCEDURE (A);
  DCL A ADDRESS,
        ARRAY BASED A (80) BYTE,
        (I,NUM) BYTE;
  CALL START$PROT$FIELD;
  I = 0;
  DO WHILE ARRAY(I) <> '#';
    IF ARRAY(I) = '$'
      THEN DO;
        CALL STOP$PROT$FIELD;
        I = I + 1;
        NUM = ARRAY(I) - 30H;
        CALL PUT$SPACE(NUM);
        CALL START$PROT$FIELD;
      END;
    ELSE DO;
      IF ARRAY(I) = '2'
        THEN DO;
          I = I + 1;

```


CRT

INTERP

```
NUM = ARRAY(I) - 30H;  
CALL PUT$SPACE(NUM);  
END;  
ELSE DO;  
CALL CRT$WRITE(ARRAY(I));  
END;  
END;  
I = I + 1;  
END;  
CALL STOP$PROT$FIELD;  
END INTERP;
```



```

/*****
*
* INIT$HIGH$SCREEN:
* THIS PROCEDURE IS USED TO INITIALIZE THE HIGH PORTION OF THE
* SCREEN, WITH A FORMAT PRE-ESTABLISHED.
*
*****/
INIT$HIGH$SCREEN: PROCEDURE PUBLIC;
CALL STOP$PROT$FIELD;
CALL SET$HIGH$HOME;
CALL INTERP(.LIN1);
CALL INTERP(.LIN2A);
CALL INTERP(.LIN2B);
CALL INTERP(.LIN3A);
CALL INTERP(.LINF);
CALL INTERP(.LIN4A);
CALL INTERP(.LINE);
CALL INTERP(.LIN5A);
CALL INTERP(.LINF);
CALL INTERP(.LIN6A);
CALL INTERP(.LINE);
CALL INTERP(.LIN5A);
CALL INTERP(.LINF);
CALL INTERP(.LIN3A);
CALL INTERP(.LINE);
CALL INTERP(.LIN9A);
CALL INTERP(.LINF);
CALL INTERP(.LIN10A);
CALL INTERP(.LINE);
CALL INTERP(.LIN3A);
CALL INTERP(.LINF);
/* TO END ROLL MODE, IF SET. */
/* LINE 1. */
/* LINE 2. */
/* LINE 3. */
/* LINE 4. */
/* LINE 5. */
/* LINE 6. */
/* LINE 7. */
/* LINE 8. */
/* LINE 9. */
/* LINE 10. */
/* LINE 11. */

```



```
CALL INTERP(. LIN12A);
CALL INTERP(. LINE);
CALL INTERP(. LIN13A);
CALL INTERP(. LINF);
CALL INTERP(. LIN3A);
CALL INTERP(. LINE);
CALL INTERP(. LIN15A);
CALL INTERP(. LINF);
CALL INTERP(. LIN16);
END INIT$HIGH$SCREEN;
```

/* LINE 12. */

/* LINE 13. */

/* LINE 14. */

/* LINE 15. */

/* LINE 16. */


```
/******  
* PRINT$TIME$ZONE:  
* THIS PROCEDURE WILL PRINT THE CURRENT TIME ZONE NUMBER.  
*  
* PARAMETERS:  
* - A - POINTER TO A STRING CONTAINING THE ASCII CHARACTERS REPRESENTING  
* THE TIME ZONE NUMBER.  
*  
*****  
PRINT$TIME$ZONE: PROCEDURE (A) PUBLIC  
  DCL A ADDRESS,  
        BUFFER BASED A (5) BYTE;  
  CALL SET$HIGH$HOME;  
  CALL CRT$PRINT$STRING(. BUFFER);  
  CALL SET$LOW$HOME;  
  END PRINT$TIME$ZONE;
```



```
*****
* PRINT$TIME:
*   THIS PROCEDURE WILL PRINT THE LOCAL TIME AT THE CRT.
*
* PARAMETERS:
*   - A - POINTER TO A STRING OF ASCII CHARACTERS REPRESENTING THE TIME.
*
*****/
PRINT$TIME: PROCEDURE (A) PUBLIC;
  DCL A ADDRESS,
        I BYTE,
        BUFFER BASED A (8) BYTE;
  CALL SET$HIGH$HOME;
  CALL PUT$TAB(1);
  DO I = 0 TO 5;
    CALL CRT$WRITE(BUFFER(1));
  END;
  CALL SET$LOW$HOME;
  END PRINT$TIME;
```



```

/*****
*
* PRINT$LAT$LONG:
* THIS PROCEDURE WILL DISPLAY THE CURRENT LATITUDE AND LONGITUDE AT THE
* CRT.
*
* PARAMETERS:
* - A - POINTER TO A STRING OF ASCII CHARACTERS REPRESENTING THE LATITUDE.
* - B - POINTER TO A STRING OF ASCII CHARACTERS REPRESENTING THE LONGITUDE.
*
*****/
PRINT$LAT$LONG: PROCEDURE (A,B) PUBLIC
    DCL (A,B) ADDRESS,
        BUFF1 BASED A (10) BYTE,
        BUFF2 BASED B (10) BYTE,
        CALL SET$HIGH$HOME;
    CALL PUT$LF(2);
    CALL PUT$TAB(16);
    CALL PUT$FS(6);
    CALL CRT$PRINT$STRING(. BUFF1);
    CALL SET$HIGH$HOME;
    CALL PUT$LF(3);
    CALL PUT$TAB(16);
    CALL PUT$FS(6);
    CALL CRT$PRINT$STRING(. BUFF2);
    CALL SET$LOW$HOME;
    END PRINT$LAT$LONG;

```



```
/******  
* PRINT$COURSE:  
* THIS PROCEDURE WILL PRINT THE CURRENT OWN COURSE VALUE AT THE  
* CRT.  
*  
* PARAMETERS:  
* - A - POINTER TO A STRING OF ASCII CHARACTERS REPRESENTING THE COURSE.  
*  
*****/  
PRINT$COURSE: PROCEDURE (A) PUBLIC;  
  DCL A ADDRESS;  
  BUFFER BASED A (6) BYTE;  
  CALL SET$HIGH$HOME;  
  CALL PUT$LF(4);  
  CALL PUT$TAB(17);  
  CALL CRT$PRINT$STRING(. BUFFER);  
  CALL SET$LOW$HOME;  
  END PRINT$COURSE;
```



```

/*****
*
* PRINT$SPEED:
* THIS PROCEDURE WILL PRINT THE CURRENT OWN SPEED AT THE CRT.
*
* PARAMETERS:
* - A - POINTER TO A STRING OF ASCII CHARACTERS REPRESENTING THE SPEED.
*
*****/
PRINT$SPEED: PROCEDURE (A) PUBLIC
  DCL A ADDRESS,
        BUFFER BASED A (5) BYTE;
  CALL SET$HIGH$HOME;
  CALL PUT$LF(5);
  CALL CRT$PRINT$STRING(, BUFFER);
  CALL SET$LOW$HOME;
  END PRINT$SPEED;

```



```
/******  
* PRINT$CONTACTS:  
* THIS PROCEDURE WILL PRINT THE NUMBER OF FRIEND, HOSTILE AND UNKNOWN  
* CONTACTS BEING PROCESSED BY THE SYSTEM.  
*  
* PARAMETERS:  
* - A - POINTER TO A STRING OF ASCII CHARACTERS REPRESENTING THE NUMBER  
* OF FRIEND, HOSTILE AND UNKNOWN CONTACTS.  
*  
*****/  
PRINT$CONTACTS: PROCEDURE (A) PUBLIC;  
  DCL A ADDRESS,  
        BUFFER BASED A (8) BYTE;  
  CALL SET$HIGH$HOME;  
  CALL PUT$LF(8);  
  CALL PUT$TAB(17);  
  CALL CRT$PRINT$STRING(. BUFFER);  
  CALL SET$LOW$HOME;  
  END PRINT$CONTACTS;
```



```
/******  
* PRINT$MODE:  
* THIS PROCEDURE WILL PRINT THE CURRENT OPERATING MODE.  
*  
* PARAMETERS:  
* - A - POINTER TO A STRING OF ASCII CHARACTERS DEFINING THE CURRENT  
* OPERATING MODE.  
*  
*****/  
PRINT$MODE: PROCEDURE (A) PUBLIC;  
  DCL A ADDRESS,  
        BUFFER BASED A (9) BYTE;  
  CALL SET$HIGH$HOME;  
  CALL PUT$LF(7);  
  CALL PUT$TAB(17);  
  CALL CRT$PRINT$STRING(. BUFFER);  
  CALL SET$LOW$HOME;  
  END PRINT$MODE;
```



```
*****  
* PRINT$CONTACT$INFO;  
* THIS PROCEDURE WILL PRINT ALL THE CURRENT INFORMATION OF ANY CONTACT  
* BEING DISPLAYED.  
*  
* PARAMETERS:  
* - NUM. - REPRESENTS THE RELATIVE POSITION FROM TOP TO BOTTOM. OF THE  
* CONTACT LINE DESIRED TO BE UPDATED.  
* - A. - POINTER TO A STRING OF ASCII CHARACTERS REPRESENTING THE CONTACT  
* INFORMATION TO BE DISPLAYED.  
*  
*****/  
PRINT$CONTACT$INFO: PROCEDURE (NUM,A) PUBLIC;  
  DCL A ADDRESS,  
  BUFFER BASED A (44) BYTE,  
  NUM BYTE;  
  CALL SET$HIGH$HOME;  
  CALL PUT$LF(NUM + 1);  
  IF NUM = 4 THEN CALL PUT$TAB(2);  
  CALL CRT$PRINT$STRING(. BUFFER);  
  CALL SET$LOW$HOME;  
  END PRINT$CONTACT$INFO;
```

END CRT;

FLTASCII

FLTASCII

FLTASCII: DO;


```
/*** EXTERNALS:  ***/
```

```
EDIV:  PROCEDURE (A,B,C,D) EXTERNAL;  
        DECLARE (A,B,C,D) ADDRESS; END;
```

```
FMUL:  PROCEDURE (A,B,C) EXTERNAL;  
        DECLARE (A,B,C) ADDRESS; END;
```

```
FDIV:  PROCEDURE (A,B,C) EXTERNAL;  
        DECLARE (A,B,C) ADDRESS; END;
```

```
FADD:  PROCEDURE (A,B,C) EXTERNAL;  
        DECLARE (A,B,C) ADDRESS; END;
```

```
FSUB:  PROCEDURE (A,B,C) EXTERNAL;  
        DECLARE (A,B,C) ADDRESS; END;
```

```
FLTDS: PROCEDURE (A,B) EXTERNAL;  
        DECLARE (A,B) ADDRESS; END;
```

```
FIXSD: PROCEDURE (A,B) EXTERNAL;  
        DECLARE (A,B) ADDRESS; END;
```



```
F2TST:
  PROCEDURE (A,B) BYTE EXTERNAL;
  DECLARE (A,B) ADDRESS; END;
```

```
DECLARE LIT LITERALLY 'LITERALLY',
        DCL LIT 'DECLARE';
```



```

/*****
*
* ASCII$TO$FLOAT:
*   PROCEDURE USED TO CONVERT A STRING OF ASCII CHARACTERS INTO A FLOATING
*   POINT NUMBER, ACCORDING TO THE FORMAT REQUIRED TO OPERATE ON THE F. P.
*   BOARD.
*
* PARAMETERS:
*   - A. - POINTER TO A N BYTE VECTOR CONTAINING THE ASCII STRING OF NUMBERS
*     REPRESENTING A DECIMAL VALUE DESIRED TO BE REPRESENTED IN FLOATING
*     POINT FORMAT. IF THE N BYTE VECTOR IS REPRESENTED BY THE
*     NAME 'BUFFER', THEN THE FOLLOWING RULES APPLY:
*     BUFFER(0). - CONTAINS THE DECIMAL NUMBER OF ASCII CHARACTERS PRE-
*     SENT IN THE BUFFER. A VALUE OF 0 WILL DENOTE THE NUM-
*     BER 0.0.
*     BUFFER(1). - CONTAINS THE DECIMAL NUMBER OF ASCII CHARACTERS THAT
*     REPRESENT THE INTEGER PORTION OF THE NUMBER. A VALUE OF
*     0 WILL MEAN THAT THE NUMBER IS LESS THAN ONE.
*     BUFFER(2) --> BUFFER(N-2). - EACH BYTE CONTAINS AN ASCII CHA-
*     RACTER. (HEXADECIMAL VALUE)
*     BUFFER(N-1). - A VALUE OF DECIMAL 1 WILL MEAN THAT THE NUMBER IS NE-
*     GATIVE.
*
*   - LIMIT. - TOTAL NUMBER OF BYTES IN 'BUFFER'. (N)
*
*   - B. - POINTER TO A FOUR BYTE VECTOR THAT WILL CONTAIN THE FLOATING POINT
*     REPRESENTATION OF THE ASCII STRING CONTAINED IN BUFFER(2) THRU
*     BUFFER(8).
*****/

```



```

ASCII$TO$FLOAT:PROCEDURE(A,LIMIT,B) PUBLIC;
    DCL (A,B) ADDRESS,
        BUFFER BASED A BYTE,
        VECTOR BASED B (4) BYTE,
        TEN$FLOAT (4) BYTE DATA (00H,00H,20H,41H),
        TEMP (4) BYTE,
        RESULT (4) BYTE,
        (I,NUMINT,NUMDEC,NUM,LIMIT,T0,T1) BYTE;

    T0 = BUFFER;
    A = A + 1;
    T1 = BUFFER;
    DO I = 0 TO 3; /* INITIALIZE VECTOR */
        VECTOR(I) = 0;
    END;

    /* CHECK IF PROPOSED NUMBER IS 0. */
    IF T0 = 0 THEN RETURN;
    NUMINT = T1;
    NUMDEC = T0 - T1;
    /* FIND INTEGER PORTION OF NUMBER. */
    DO WHILE NUMINT > 0;
        DO I = 0 TO 3;
            TEMP(I) = 0;
        END;
        A = A + 1;
        TEMP(0) = BUFFER - 30H;
        CALL FLTDC(.TEMP,.RESULT);
        IF NUMINT > 1 THEN DO;
            DO I = 1 TO NUMINT - 1;
                CALL FMUL(.RESULT,.TEN$FLOAT,.RESULT);
            END;
        END;
    END;

```



```

        END;
        CALL FADD(.RESULT,.VECTOR,.VECTOR);
        NUMINT = NUMINT - 1;
        END;

/*      FIND DECIMAL PORTION OF NUMBER PROPOSED.  */
        NUM = 0;
        DO WHILE NUMDEC > 0;
            DO I = 0 TO 3;
                TEMP(I) = 0;
            END;
            A = A + 1;
            NUM = NUM + 1;
            TEMP(0) = BUFFER - 30H;
            CALL FLTDS(.TEMP,.RESULT);
            DO I = 1 TO NUM;
                CALL FDIV(.RESULT,.TEN$FLOAT,.RESULT);
            END;
            CALL FADD(.RESULT,.VECTOR,.VECTOR);
            NUMDEC = NUMDEC - 1;
        END;

/*      CHECK FOR SIGN OF NUMBER PROPOSED.  */
        A = A + 1;
        IF BUFFER = 1 THEN VECTOR(3) = VECTOR(3) XOR 80H;

/*      ALL DONE. RETURN TO CALLING MODULE.  */
        RETURN;
        END ASCII$TO$FLOAT;

```



```

/*****
*
*   FRAC$TO$ASCII:
*   PROCEDURE USED TO CONVERT A FRACTIONAL PART OF A F.P. NUMBER
*   INTO AN ASCII REPRESENTATION AND STORE IT IN A BUFFER.
*
*   PARAMETERS:
*   - A - POINTER TO A VARIABLE - WHICH CONTAINS THE FRACTIONAL PART OF A
*       F.P. NUMBER- PASSED BY FLOAT$TO$ASCII PROCEDURE.
*   - B - POINTER TO A BUFFER PARTIALLY FILLED W/ THE INTEGER PART OF
*       A F.P. NUMBER CONVERTED TO ASCII BY FLOAT$TO$ASCII.
*   - DEC$POS - POINTER TO A VARIABLE WHICH INDICATES THE POSITION OF DECIMAL
*       POINT TO BE SET ; IT RETURN THE ADDRESS WHICH CONTAINS
*       THE FIRST VACANT POSITION IN THE BUFFER AFTER FILLED.
*
*****/
FRAC$TO$ASCII: PROCEDURE (A,B,DEC$POS);
    DCL (A,B,DEC$POS) ADDRESS;
    DCL TERM BASED A (4) BYTE,
        BUFF BASED B (28) BYTE,
        C BASED DEC$POS BYTE;
    DCL TEN$FLOAT (4) BYTE DATA (00H,00H,20H,41H);
    DCL TEMP (4) BYTE, TEMP1 BYTE DATA (4),
        (FLAG, 1) BYTE;

    BUFF(C) = ',';
    C = C + 1;
    FLAG = 0FFH;
    DO WHILE FLAG;
        CALL FMUL (C,TERM, TEN$FLOAT, .TERM);
        CALL FIXED (C,TERM, .TEMP);
        /* SET UP FRAC PART OF F.P. NUMBER TO ASCII */

```



```
      BUFF(C) = TEMP(0) + 30H;  
      CALL FLTDS (.TERM, .TEMP);  
      CALL FSUB (.TERM, .TEMP, .TERM);  
      C = C + 1;  
      IF C = 26 THEN RETURN;  
      FLAG = NOT (FLAG = FZTST (.TERM, .TEMP1));  
      END;  
      RETURN;  
END FRAC$TO$ASCII;
```



```

/*****
*
*   FLOAT$TO$ASCII:
*   PROCEDURE USED TO CONVERT A FLOATING POINT NUMBER -SEE INTEL SEC 310-
*   INTO AN ASCII REPRESENTATION AND STORE IT IN A BUFFER TO BE SENT TO THE
*   CALLING MODULE.
*
*   PARAMETERS:
*   - FLOAT -POINTER TO A VARIABLE -WHICH CONTAINS THE F.P. NUMBER- PASSED
*     BY THE CALLING MODULE;
*   - ASC$BUFFER -POINTER TO A BUFFER W/ LENGTH 28 WHICH CONTAINS THE ASCII
*     REPRESENTATION OF THE F.P. NO.;
*   - END$BUFFER - POINTER TO VARIABLE PASSED TO THE CALLING MODULE INDICA-
*     TING THE FIRST VACANT BYTE OF BUFFER AFTER LAST PRINTABLE
*     ASCII BYTE.
*
*****/
FLOAT$TO$ASCII: PROCEDURE (FLOAT,ASC$BUFFER,END$BUFFER) PUBLIC;
  DCL (FLOAT,ASC$BUFFER,END$BUFFER) ADDRESS,
    M BASED FLOAT (4) BYTE,
    A BASED ASC$BUFFER (28) BYTE,
    DEC$POINT BASED END$BUFFER BYTE,
    ONE (4) BYTE DATA (00H,00H,00H,3FH),
    TEN (2) BYTE DATA (0AH,00H),
    (TEMP, TEMP2, FRAC, REM) (4) BYTE,
    (TEMP1, I, SIGN, EXP, FLAG) BYTE;

  DO I = 0 TO LAST(A);
    A(I) = ' ';
  END;
  SIGN = M(3) AND 80H;
  DO I = 0 TO LAST(A);
    /* INITIALIZE BUFFER */

```



```

IF SIGN = 80H THEN A(0) = '-'
ELSE A(0) = ' '
EXP = SHL(M(3),1) OR SHR(M(2),7)
TEMP(3) = M(3)
TEMP(2) = M(2)
TEMP(1) = M(1)
TEMP(0) = M(0)
IF ((EXP < 7FH) AND (EXP >= 00H)) THEN I = 0
IF EXP = 7FH THEN I = 1
IF ((EXP <= 0FEH) AND (EXP > 7FH)) THEN I = 2
DO CASE I
    /* CASE 0: APPLIED FOR -1.0 < F.P. NUMBERS < 1.0 */
    DEC$POINT = 2
    A(1) = '0'
    TEMP(3) = TEMP(3) AND 7FH
    CALL FRAC$TO$ASCII (.TEMP, A, DEC$POINT)
    END
DO
    /* CASE 1: APPLIED FOR 2.0 > F.P. NUMBER >= 1.0
       OR -2.0 < F.P. NUMBER <= -1.0 */
    DEC$POINT = 2
    A(1) = '1'
    TEMP(3) = TEMP(3) AND 7FH
    CALL FSUB (.TEMP, ONE, TEMP)
    CALL FRAC$TO$ASCII (.TEMP, A, DEC$POINT)
    END
DO
    /* CASE 2: APPLIED FOR -1.0 > F.P. NUMBER > 1.0 */
    DEC$POINT = 1
    EXP = EXP - 7FH
    /* TAKE OUT BIAS OF EXPONENT */
    DO I = 1 TO 23 - EXP
    /* NEXT 2 INTERACTIVES "DO" TAKE OUT FRACTIONAL PART OF F.P. NUMBER */

```



```

TEMP(2) = SCR(TEMP(2),1);
TEMP(1) = SCR(TEMP(1),1);
IF CARRY THEN TEMP(0) = SHR(TEMP(0),1) OR 80H;
ELSE TEMP(0) = SHR(TEMP(0),1);
END;

EXP = EXP OR EXP; /* RESET CARRY BIT */
DO I = 1 TO 23 - EXP;
TEMP(0) = SCL(TEMP(0),1);
TEMP(1) = SCL(TEMP(1),1);
IF CARRY THEN TEMP(2) = SHL(TEMP(2),1) OR 01H;
ELSE TEMP(2) = SHL(TEMP(2),1);
END;

CALL FSUB (M, TEMP, FRAC); /* SAVE FRAC PART OF F.P. NUMBER */
FRAC(3) = FRAC(3) AND 7FH;
CALL FIXED (TEMP, TEMP);
IF (TEMP1 := TEMP(3) AND 80H) = 80H THEN
DO; /* PERFORMS TWO'S COMPLEMENT OF A NEGATIVE F.P. NUMBER */
TEMP(0) = NOT TEMP(0); TEMP(1) = NOT TEMP(1);
TEMP(2) = NOT TEMP(2); TEMP(3) = NOT TEMP(3);
TEMP(0) = TEMP(0) + 1; TEMP(1) = TEMP(1) PLUS 0;
TEMP(2) = TEMP(2) PLUS 0; TEMP(3) = TEMP(3) PLUS 0;
END;

FLAG = 0FFH;
DO WHILE FLAG; /* SET UP INTEGER PART OF F.P. NUMBER TO ASCII */
CALL EDIV (TEMP, TEN, TEMP, REM);
A(DEC$POINT) = REN(0) + 30H;
DEC$POINT = DEC$POINT + 1;
CALL FLTDS (TEMP, TEMP);
TEMP1 = 4;
FLAG = NOT (FLAG := FZTST (TEMP, TEMP1));
CALL FIXED (TEMP, TEMP);

```



```
END;
DO I = 1 TO DEC$POINT/2;
  TEMP1 = A(I);
  A(I) = A(DEC$POINT - I);
  A(DEC$POINT - I) = TEMP1;
END;
CALL FRAC$TO$ASCII (.FRAC.,A,.DEC$POINT);
END;

END;
RETURN;
END FLOAT$TO$ASCII;

END FLTASCII;
```


FLOATING#POINT

FLOATING#POINT

FLOATING#POINT: DO;


```

/****  DECLARATIONS:  ****/

DECLARE LIT LITERALLY 'LITERALLY',
      DCL LIT 'DECLARE';

DCL
  MEBAS ADDRESS PUBLIC DATA (0F790H) ,
  RES$TABLE (8) BYTE PUBLIC AT (0F790H), /* MEMORY RESERVED FOR F.P. BOARD. */
  OUT$OP$CODE LIT '010H', /* BASE OUTPUT PORT FOR F.P. BOARD. */
  IN$STATUS LIT '011H', /* INPUT PORT FOR STATUS OF F.P. BOARD. */
  IN$FLAG LIT '017H', /* INPUT PORT FOR FLAG FROM F.P. BOARD. */
  MEM$LOW LIT '011H', /* OUTPUT PORT FOR LOW PORTION OF MEMORY BASE. */
  MEM$HIGH LIT '012H', /* OUTPUT PORT FOR HIGH PORTION OF MEMORY BASE. */
  MUL$CODE LIT '00H', /* FIXED POINT MULTIPLICATION CODE. */
  DIV$CODE LIT '01H', /* FIXED POINT DIVISION CODE. */
  FMUL$CODE LIT '02H', /* F.P. MULTIPLICATION CODE. */
  FDIV$CODE LIT '03H', /* F.P. DIVISION CODE. */
  FADD$CODE LIT '04H', /* F.P. ADD CODE. */
  FSUB$CODE LIT '05H', /* F.P. SUBTRACT CODE. */
  FSQR$CODE LIT '06H', /* F.P. SQUARE CODE. */
  FSQRT$CODE LIT '07H', /* F.P. SQUARE ROOT CODE. */
  FLTDS$CODE LIT '08H', /* FIXED-TO-FLOAT CONVERSION CODE. */
  FIXSD$CODE LIT '09H', /* FLOAT-TO-FIXED CONVERSION CODE. */
  FCMPR$CODE LIT '0AH', /* F.P. COMPARE CODE. */
  FZTST$CODE LIT '0EH', /* F.P. TEST CODE. */
  EXCH$CODE LIT '0FH', /* EXCHANGE CODE. */
  EDIV$CODE LIT '0EH', /* EXTENDED FIXED POINT DIVISION CODE. */
  BUSY$MASK LIT '01H', /* MASK FOR BUSY SIGNAL FROM F.P. BOARD. */
  ERROR$MASK LIT '04H'; /* MASK FOR ERROR CODE FROM F.P. BOARD. */

```



```
/*** EXTERNALS: ***/
```

```
CRT$PRINT$STRING:PROCEDURE (A) EXTERNAL;
  DECLARE A ADDRESS;
  END CRT$PRINT$STRING;
```

```
SEND$CRLF: PROCEDURE EXTERNAL;
  END SEND$CRLF;
```



```

/*****
*
* INIT$FP:
*   PROCEDURE USED TO INITIALIZE THE FLOATING POINT MODULE.
*
* USAGE:
*   THIS PROCEDURE SHOULD BE CALLED ONE TIME FROM THE USER'S
*   MAIN PROGRAM BEFORE ATTEMPTING TO USE ANY OF THE ROUTINES PROVIDED FOR FLOATING POINT OPERATIONS WITH THE FLOATING POINT BOARD.
*
*****/
INIT$FP: PROCEDURE PUBLIC;
  OUTPUT(MEM$LOW) = LOW(MEBAS);
  OUTPUT(MEM$HIGH) = HIGH(MEBAS);
  RETURN;
END INIT$FP;

```



```

/*****
*
* ADJUST$OP:
*   PROCEDURE USED TO PUT TWO VECTORS INTO THE TABLE VECTOR.
*
* PARAMETERS:
*   - A,B - POINTERS TO FIRST AND SECOND VECTOR VALUES.
*
*****/
ADJUST$OP: PROCEDURE(A,B);
  DCL (A,B) ADDRESS,
        OP1 BASED A (4) BYTE,
        OP2 BASED B (4) BYTE,
        I BYTE;
  DO I = 0 TO LAST(OP1);
    RES$TABLE(I) = OP1(I);
    RES$TABLE(I + 4) = OP2(I);
  END;
RETURN;
END ADJUST$OP;

```



```

/*****
*
* ADJUST1$OP:
*   PROCEDURE USED TO PUT ONE VECTOR INTO THE TABLE VECTOR.
*
* PARAMETERS:
*   - A - POINTER TO VECTOR VALUE.
*
*****/
ADJUST1$OP: PROCEDURE (A);
  DCL A ADDRESS,
        OP1 BASED A (4) BYTE,
        I BYTE;
  DO I = 0 TO LAST(OP1);
    RES$TABLE(I) = OP1(I);
  END;
  RETURN;
END ADJUST1$OP;

```



```

/*****
*
* ADJUST2$OP:
*   PROCEDURE USED TO PUT TWO ADDRESS VALUES INTO THE TABLE VECTOR.
*
* PARAMETERS:
*   - A,B - POINTERS TO TWO ADDRESS VALUES.
*
*****/
ADJUST2$OP: PROCEDURE (A,B);
  DCL (A,B) ADDRESS;
  OP1 BASED A (2) BYTE;
  OP2 BASED B (2) BYTE;
  I BYTE;
  DO I = 0 TO LAST(OP1);
    RES$TABLE(I) = OP1(I);
    RES$TABLE(I + 4) = OP2(I);
  END;
  RETURN;
END ADJUST2$OP;

```



```

/*****
*
* VAL$RESULT:
* PROCEDURE USED TO GET THE RESULT IN FIRST FOUR BYTES OF THE
* TABLE VECTOR, AND PUT IT INTO ANOTHER VECTOR PROVIDED.
*
* PARAMETERS:
* - C. - POINTER TO VECTOR ON WHICH RESULT IS DESIRED.
*
*****/
VAL$RESULT: PROCEDURE(C);
  DCL C ADDRESS,
        RESULT BASED C (4) BYTE,
        I BYTE;
  DO I = 0 TO LAST(RESULT);
    RESULT(I) = RES$TABLE(I);
  END;
  RETURN;
END VAL$RESULT;

```



```

/*****
*
* VAL$RESULT$1:
* PROCEDURE USED TO PUT ALL EIGHT BYTES OF THE TABLE VECTOR
* INTO TWO FOUR BYTES VECTORS PROVIDED.
*
* PARAMETERS:
* - A,B - POINTERS TO VECTORS ON WHICH RESULT IS DESIRED. A
* MUST POINT TO FIRST VECTOR (FIRST FOUR BYTES OF
* TABLE), AND B MUST POINT TO THE SECOND VECTOR (LAST FOUR
* BYTES IN TABLE).
*
*****/
VAL$RESULT$1: PROCEDURE(A,B);
  DCL (A,B) ADDRESS,
    OP1 BASED B (4) BYTE,
    OP2 BASED A (4) BYTE,
    I BYTE;
  DO I = 0 TO LAST(OP1);
    OP2(I) = RES$TABLE(I);
    OP1(I) = RES$TABLE(I + 4);
  END;
  RETURN;
END VAL$RESULT$1;

```



```

/*****
*
* VAL$RESULT#2:
* PROCEDURE USED TO GET THE RESULT FROM FIXED POINT
* DIVISION OPERATION, AND PUT THEM INTO TWO ADDRESS
* LOCATIONS PROVIDED.
*
* PARAMETERS:
* - C,R - POINTERS TO TWO ADDRESS LOCATIONS IN WHICH THE
* RESULT IS DESIRED TO BE PLACED.
*
*****/
VAL$RESULT#2: PROCEDURE (C,R);
  DCL (C,R) ADDRESS,
    OP1 BASED C (2) BYTE,
    OP2 BASED R (2) BYTE,
    I BYTE;
  DO I = 0 TO LAST(OP1);
    OP1(I) = RES$TABLE(I);
    OP2(I) = RES$TABLE(I + 4);
  END;
END VAL$RESULT#2;

```



```

/*****
*
* COMPARE:
*   PROCEDURE USED TO CHECK FOR OUTPUT CONDITIONS FROM F.P. BOARD.
*
* PARAMETERS:
*   - A - BYTE VALUE CONTAINING RESULT FROM F.P. BOARD.
*   - B - BYTE VALUE CONTAINING CONDITION DESIRED TO BE CHECKED:
*
*       < ..... 0
*       <= ..... 1
*       > ..... 2
*       >= ..... 3
*       = ..... 4
*       <> ..... 5
*
* USAGE:
*   TYPED PROCEDURE THAT RETURNS A 'TRUE' VALUE (001H) IF OUTPUT
*   CONDITION FROM F.P. BOARD AND CONDITION DESIRED TO BE TESTED
*   ARE SIMILAR. IF NOT SIMILAR, A 'FALSE' VALUE (000H) IS RETURNED.
*
*****/
COMPARE: PROCEDURE (A,B) BYTE;
  DCL TRUE LIT '01H',
  FALSE LIT '00H';
  DCL (A,B) BYTE,
  (LESS$THAN, LESS$OR$EQUAL, GREATER$THAN, GREAT$OR$EQUAL, EQUAL, NOT$EQUAL)
  BYTE DATA (0,1,2,3,4,5);
  IF ((A = 80H) AND ((B = LESS$OR$EQUAL) OR (B = GREAT$OR$EQUAL) OR
  (B = EQUAL))) THEN RETURN TRUE;
  IF ((A = 40H) AND ((B = GREATER$THAN) OR (B = GREAT$OR$EQUAL) OR
  (B = NOT$EQUAL))) THEN RETURN TRUE;
  IF ((A = 20H) AND ((B = LESS$THAN) OR (B = LESS$OR$EQUAL) OR

```



```

        (B = NOT$EQUAL)) THEN RETURN TRUE;
    RETURN FALSE;
END COMPARE;
    
```



```

/*****
*
* FLOAT$MSG$ERROR:
* PROCEDURE USED TO SEND A MESSAGE ERROR ACCORDING TO ERROR
* CODE PROVIDED BY F.P. BOARD.
*
* USAGE:
* UNTYPED PROCEDURE. IF CONDITION OF ERROR IS DETECTED, THIS
* PROCEDURE MUST BE CALLED IN ORDER TO OBTAIN ERROR CODE AND
* DISPLAY AN APPROPRIATE MESSAGE. NOTE THAT PROGRAM EXECUTION
* WILL BE STOPPED AND INTERRUPTS WILL BE ENABLED IF AN ERROR
* IS DETECTED.
*
*****/
FLOAT$MSG$ERROR: PROCEDURE;
    DCL MSG1(*) BYTE DATA ('DIVISION BY ZERO. $$'),
        MSG2(*) BYTE DATA ('DOMAIN ERROR. $$'),
        MSG3(*) BYTE DATA ('OVERFLOW. $$'),
        MSG4(*) BYTE DATA ('UNDERFLOW. $$'),
        MSG5(*) BYTE DATA ('INVALID FORMAT FOR FIRST ARGUMENT. $$'),
        MSG6(*) BYTE DATA ('INVALID FORMAT FOR SECOND ARGUMENT. $$'),
        ERROR(*) BYTE DATA (' FATAL ERROR. $$'),
        I BYTE;
    I = INPUT(IN$STATUS) AND 07H;
    DO CASE I;
    ,
    CALL CRT$PRINT$STRINGC. MSG1);
    CALL CRT$PRINT$STRINGC. MSG2);
    CALL CRT$PRINT$STRINGC. MSG3);
    CALL CRT$PRINT$STRINGC. MSG4);
    CALL CRT$PRINT$STRINGC. MSG5);

```


FL0AT I NG\$POINT

FL0AT\$MSG\$ERROR

```
CALL CRT$PRINT$STRING(. MSG$);  
;  
END;  
CALL CRT$PRINT$STRING(. ERROR);  
CALL SEND$CRLF;  
RETURN;  
END FL0AT$MSG$ERROR;
```


FLOATING\$POINT

CHECK

```

/*****
*
*
* CHECK:
*   PROCEDURE USED TO CHECK FOR STATUS OF F.P. BOARD AND TO DETECT IF
*   ANY ERROR HAS OCCURRED.
*
* USAGE:
*   UNTYPED PROCEDURE THAT IS CALLED BY ALL PROCEDURES THAT TRY TO EXECUTE
*   A FLOATING POINT OPERATION WITH THE F.P. BOARD.
*
*****/
CHECK: PROCEDURE
  DCL I BYTE;
  DO WHILE (I:=INPUT(IN$FLAG)) AND BUSY$MASK = BUSY$MASK
    END;
  IF (I AND ERROR$MASK) = ERROR$MASK
    THEN DO;
      CALL FLOAT$MSG$ERROR;
      HALT;
    END;
  RETURN;
END CHECK;

```



```

/*****
*
* MUL:
* PROCEDURE USED TO PERFORM FIXED POINT MULTIPLICATION USING THE F.P.
* BOARD.
*
* PARAMETERS:
* - A. - POINTER TO A 2 BYTE VECTOR (ADDRESS VALUE) IN WHICH THE FIRST
* OPERAND WILL BE LOCATED.
* - B. - POINTER TO A 2 BYTE VECTOR (ADDRESS VALUE) IN WHICH THE SECOND
* OPERAND WILL BE LOCATED.
* - C. - POINTER TO A 2 BYTE VECTOR (ADDRESS VALUE) IN WHICH THE RESULT
* IS DESIRED TO BE PLACED. NOTICE THAT IT COULD BE THE SAME
* LOCATION USED FOR ANY OF THE OPERANDS.
*
*****/
MUL: PROCEDURE (A,B,C) PUBLIC;
    DCL (A,B,C) ADDRESS;
    CALL ADJUST$OP (A,B);
    OUTPUT(OUT$OF$CODE) = MUL$CODE;
    CALL CHECK;
    CALL VAL$RESULT (C);
    RETURN;
END MUL;

```



```

/*****
*
* DIV:
* PROCEDURE USED TO PERFORM FIXED POINT DIVISION USING THE
* F.P. BOARD.
*
* PARAMETERS:
* - A - POINTER TO A 2 BYTE VECTOR (ADDRESS VALUE) IN WHICH THE DIVI-
*   DEND IS LOCATED.
* - B - POINTER TO A 2 BYTE VECTOR (ADDRESS VALUE) IN WHICH THE DIVI-
*   SOR IS LOCATED.
* - C - POINTER TO A 2 BYTE VECTOR (ADDRESS VALUE) IN WHICH THE RESULT
*   (QUOTIENT) IS DESIRED TO BE PLACED.
* - R - POINTER TO A 2 BYTE VECTOR (ADDRESS VALUE) IN WHICH THE REMAIN-
*   DER IS DESIRED TO BE PLACED. NOTICE THAT C AND R COULD POINT TO ANY
*   OF THE TWO OPERANDS IF SO DESIRED.
*
*****/
DIV: PROCEDURE (A,B,C,R) PUBLIC;
  DCL (A,B,C,R) ADDRESS;
  CALL ADJUST$OP(A,B);
  OUTPUT(OUT$OP$CODE) = DIV$CODE;
  CALL CHECK;
  CALL VAL$RESULT#2(C,R);
  RETURN;
END DIV;

```



```

/*****
*
* EDIV:
* PROCEDURE USED TO PERFORM EXTENDED FIXED POINT DIVISION USING THE
* F. P. BOARD.
*
* PARAMETERS:
* - A - POINTER TO A 4 BYTE VECTOR THAT WILL PROVIDE THE DIVIDEND.
* - B - POINTER TO A 4 BYTE VECTOR THAT WILL PROVIDE THE DIVISOR.
* - C - POINTER TO A 4 BYTE VECTOR IN WHICH THE QUOTIENT WILL BE RETURNED.
* - R - POINTER TO A 4 BYTE VECTOR IN WHICH THE REMAINDER WILL BE RETURNED.
*
*****/
EDIV: PROCEDURE (A,B,C,R) PUBLIC;
DECL (A,B,C,R) ADDRESS,
      OP2 BASED B (2) BYTE,
      I BYTE;
  CALL ADJUST1$OP (A);
  DO I = 0 TO LAST(OP2);
    RES$TABLE(I + 4) = OP2(I);
  END;
  OUTPUT(OUT$OP$CODE) = EDIV$CODE;
  CALL CHECK;
  CALL VAL$RESULT$1 (C,R);
  RETURN;
END EDIV;

```


FLOATING\$POINT

FMUL

```

/*****
*
* FMUL:
* PROCEDURE USED TO PERFORM FLOATING POINT MULTIPLICATION USING THE
* F.P. BOARD.
*
* PARAMETERS:
* -A,B,C - POINTERS TO 3 FOUR BYTE VECTORS THAT POINT TO THE TWO OPERANDS
* AND THE RESULT RESPECTIVELY. NOTE THAT THE RESULT COULD BE THE SAME
* VECTOR USED TO INDICATE ANY OPERAND.
*
*****/
FMUL: PROCEDURE (A,B,C) PUBLIC;
  DCL (A,B,C) ADDRESS;
  CALL ADJUST$OP(A,B);
  OUTPUT(OUT$OP$CODE) = FMUL$CODE;
  CALL CHECK;
  CALL VAL$RESULT(C);
  RETURN;
END FMUL;

```



```

/*****
*
*   FDIV:
*   PROCEDURE USED TO PERFORM FLOATING POINT DIVISION USING THE F.P BOARD.
*
*   PARAMETERS:
*   - A,B,C - POINTERS TO 3 FOUR BYTE VECTORS THAT WILL POINT TO THE DIVIDEND
*             AND THE DIVISOR ON THE FIRST TWO, AND THE RESULT ON THE THIRD. NOTE
*             THAT THE RESULT COULD BE PUT IN THE SAME PLACE OF ANY OPERAND IF SO
*             DESIRED.
*
*   *****/
FDIV: PROCEDURE (A,B,C) PUBLIC;
      DCL (A,B,C) ADDRESS;
      CALL ADJUSTOP (A,B);
      OUTPUT(OUT$OP$CODE) = FDIV$CODE;
      CALL CHECK;
      CALL VAL$RESULT(C);
      RETURN;
      END FDIV;

```



```

/*****
*
* FADD:
*   PROCEDURE USED TO PERFORM FLOATING POINT ADDITION USING THE F.P. BOARD.
*
* PARAMETERS:
*   - A,B,C - POINTERS TO 3 FOUR BYTE VECTORS. THE FIRST TWO POINT TO THE
*   TWO OPERANDS, AND THE THIRD ONE POINTS TO THE VECTOR RESULT. NOTE
*   THAT THE RESULT COULD ALSO BE PLACED IN ANY OF THE OPERAND VECTORS.
*
*****/
FADD: PROCEDURE (A,B,C) PUBLIC;
      DCL (A,B,C) ADDRESS;
      CALL ADJUST$OP (A,B);
      OUTPUT(OUT$OP$CODE) = FADD$CODE;
      CALL CHECK;
      CALL VAL$RESULT (C);
      RETURN;
      END FADD;

```



```

/*****
*
* FSUB:
* PROCEDURE USED TO PERFORM FLOATING POINT SUBTRACTION USING THE
* F.P. BOARD.
*
* PARAMETERS:
* - A,B,C - POINTERS TO 3 FOUR BYTE VECTORS. THE FIRST TWO POINT TO
* BOTH OPERANDS, AND THE THIRD ONE POINTS TO THE VECTOR WHERE THE
* RESULT IS DESIRED TO BE PLACED. NOTE THAT THE RESULT COULD BE
* PLACED IN ANY OF BOTH OPERANDS.
*
*****/
FSUB: PROCEDURE (A,B,C) PUBLIC;
    DCL (A,B,C) ADDRESS;
    CALL ADJUST$OP (A,B);
    OUTPUT(OUT$OP$CODE) = FSUB$CODE;
    CALL CHECK;
    CALL VAL$RESULT (C);
    RETURN;
END FSUB;

```



```

/*****
*
* FSQR:
*   PROCEDURE USED TO PERFORM A FLOATING POINT SQUARE USING THE F. P.
*   BOARD.
*
* PARAMETERS:
*   - A,C - POINTERS TO 2 FOUR BYTE VECTORS. A POINTS TO A VECTOR IN WHICH
*     A FLOATING POINT QUANTITY IS LOCATED AND TO WHICH ITS SQUARE WILL BE
*     OBTAINED. C POINTS TO A VECTOR IN WHICH THE RESULT IS DESIRED TO BE
*     PLACED. NOTE THAT A AND C COULD POINT TO THE SAME VECTOR.
*
*****/
FSQR: PROCEDURE (A,C) PUBLIC
  DCL (A,C) ADDRESS;
  CALL ADJUST1$OP(A);
  OUTPUT(OUT$OP$CODE) = FSQR$CODE;
  CALL CHECK;
  CALL VAL$RESULT (C);
  RETURN;
END FSQR;

```



```

/*****
*
* FLTDS:
* PROCEDURE USED TO PERFORM A FIXED-TO-FLOAT CONVERSION USING THE F. P.
* BOARD.
*
* PARAMETERS:
* - A,C - POINTERS TO 2 FOUR BYTE VECTORS. A POINTS TO A VECTOR CONTAINING
* A FIXED POINT INTEGER AND C POINTS TO A VECTOR WHERE THE SINGLE PRE-
* CISION FLOATING POINT REPRESENTATION OF THE SAME VALUE, IS DESIRED TO
* BE PLACED. NOTE THAT BOTH, A AND C, COULD POINT TO THE SAME VECTOR.
*
*****/
FLTDS: PROCEDURE (A,C) PUBLIC;
    DCL (A,C) ADDRESS;
    CALL ADJUST1$OF (A);
    OUTPUT(OUT$OP$CODE) = FLTDS$CODE;
    CALL CHECK;
    CALL VAL$RESULT (C);
    RETURN;
END FLTDS;

```



```

**
** *****
** FIXED:
** PROCEDURE USED TO PERFORM A FLOAT-TO-FIXED CONVERSION USING THE F.P.
** BOARD.
**
** *****
** PARAMETERS:
** - A.C. - POINTERS TO 2 FOUR BYTE VECTORS. A POINTS TO A VECTOR CONTAINING
**   THE FIXED POINT QUANTITY DESIRED TO BE CONVERTED. C POINTS TO A VECTOR
**   IN WHICH THE CONVERSION IS DESIRED TO BE PLACED. NOTE THAT BOTH COULD
**   POINT TO THE SAME VECTOR.
** *****
**
** *****
FIXSD: PROCEDURE (A,C) PUBLIC
    DCL (A,C) ADDRESS;
    CALL ADJUST1$OP (A);
    OUTPUT(OUT$OP#CODE) = FIXSD#CODE;
    CALL CHECK;
    CALL VAL#RESULT (C);
    RETURN;
END FIXSD;

```



```
/******  
*  
* FSORT:  
* PROCEDURE TO PERFORM THE SQUARE ROOT OF A FLOATING POINT NUMBER USING  
* THE F.P. BOARD.  
*  
* PARAMETERS:  
* - A,C - POINTERS TO 2 FOUR BYTE VECTORS. A POINTS TO THE VECTOR CONTAINING  
* THE NUMBER TO WHICH ITS SQUARE ROOT WILL BE OBTAINED. C POINTS TO THE  
* VECTOR IN WHICH THE RESULT WILL BE PLACED. NOTE THAT BOTH POINTERS  
* COULD BE REFERING TO THE SAME VECTOR.  
*  
*****/  
FSORT: PROCEDURE (A,C) PUBLIC;  
  DECL (A,C) ADDRESS;  
  CALL ADJUST1$OP (A);  
  OUTPUT(OUT$OP$CODE) = FSORT$CODE;  
  CALL CHECK;  
  CALL VAL$RESULT (C);  
  RETURN;  
END FSORT;
```



```

/*****
*
* FCMPR:
*   PROCEDURE USED TO COMPARE TWO FLOATING POINT NUMBERS USING THE F.P. BOARD.
*
* PARAMETERS:
*   - A,B - POINTERS TO 2 FOUR BYTE VECTORS CONTAINING THE TWO FLOATING
*     POINT NUMBERS DESIRED TO BE COMPARED.
*   - C - POINTS TO A BYTE VALUE CONTAINING THE CODE CORRESPONDING TO THE
*     TYPE OF COMPARISON DESIRED:
*       < ..... 0
*       <= ..... 1
*       > ..... 2
*       >= ..... 3
*       = ..... 4
*       <> ..... 5
*
* USAGE:
*   TYPED PROCEDURE. IF THE RELATION DESIRED TO BE TESTED HOLDS, A VALUE OF
*   '01H' (TRUE) IS RETURNED, OTHERWISE A VALUE OF '00H' (FALSE) WILL BE
*   RETURNED.
*
*****/
FCMPR: PROCEDURE (A,B,C) BYTE PUBLIC;
  DCL (A,B,C) ADDRESS;
  (TEST BASED C,RESULT, FLAG) BYTE;
  FLAG = 000H; /* RESET FLAG USED TO CHECK TWO NEGATIVE NUMBERS. */
  CALL ADJUST$OP (A,B);
  IF (RES#TABLE(3) >= 80H) AND
    (RES#TABLE(7) >= 80H)
  THEN FLAG = 0FFH;

```



```

OUTPUT(OUT$OF$CODE) = FCMPR$CODE;
CALL CHECK;
RESULT = INPUT (IN$STATUS) AND 0E0H;
IF FLAG AND (RESULT <> 80H)
THEN DO;
    IF RESULT = 40H
    THEN RESULT = 20H;
    ELSE RESULT = 40H;
END;
RETURN (RESULT := COMPARE(RESULT,TEST));
END FCMPR;

```



```

/*****
*
* FZTST:
*   PROCEDURE USED TO TEST A FLOATING POINT NUMBER AGAINST 0.0 USING THE F.P.
*   BOARD.
*
* PARAMETERS:
*   - A1 - POINTER TO A FOUR BYTE VECTOR CONTAINING THE FLOATING POINT VALUE
*     DESIRED TO BE TESTED.
*   - C - POINTER TO A BYTE VALUE CONTAINING THE CODE OF THE COMPARISON DESI-
*     RED, ACCORDING TO THE FOLLOWING RULES:
*
*       < ..... 0
*       <= ..... 1
*       > ..... 2
*       >= ..... 3
*       = ..... 4
*       <> ..... 5
*
* USAGE:
*   TYPED PROCEDURE. IF THE RELATION DESIRED TO BE TESTED HOLDS, A VALUE OF
*   '01H' (TRUE) IS RETURNED, OTHERWISE A VALUE OF '00H' (FALSE) WILL BE RE-
*   TURNED.
*
*****/
FZTST: PROCEDURE (A,C) BYTE PUBLIC;
  DCL (A,C) ADDRESS,
    OP1 BASED A (4) BYTE,
    (TEST BASED C, RESULT, I) BYTE;
  DCL LOWER$BOUND (4) BYTE DATA (0E2H,0FAH,0FFH,0B4H), /* -0.00000009 */
    UPPER$BOUND (4) BYTE DATA (0E2H,0FAH,0FFH,034H), /* 0.00000009 */
    LOW BYTE DATA (01H), /* LESS THAN OR EQUAL */

```



```

HIGH BYTE DATA (03H); /* GREATER THAN OR EQUAL */

/* CHECK IF NUMBER IS IN BOUNDARIES OF DEFINED SYSTEM ZERO */
IF (TEST <> 0) AND (TEST <> 2) AND
  (FCMPR( OP1, .LOWER$BOUND, .HIGH) ) AND
  (FCMPR( OP1, .UPPER$BOUND, .LOW) )
THEN DO;
  DO I = 0 TO 3;
    OP1(I) = 00H;
  END;
END;
CALL ADJUST1$OP (A);
OUTPUT(OUT$OP$CODE) = FZTST$CODE;
CALL CHECK;
RESULT = INPUT (IN$STATUS) AND 000H;
RETURN (RESULT := COMPARE(RESULT, TEST));
END FZTST;

```



```
/******  
*  
* EXCH:  
* PROCEDURE USED TO EXCHANGE TWO FLOATING POINT VALUES USING THE F.P.  
* BOARD.  
*  
* PARAMETERS:  
* - A,C - POINTERS TO 2 FOUR BYTE VECTORS CONTAINING TWO FLOATING  
* POINT NUMBERS DESIRED TO BE EXCHANGED.  
*  
*****/  
EXCH: PROCEDURE (A,C) PUBLIC  
  DCL (A,C) ADDRESS;  
  CALL ADJUST$OP (A,C);  
  OUTPUT(OUT$OP$CODE) = EXCH$CODE;  
  CALL CHECK;  
  CALL VAL$RESULT$1(A,C);  
  RETURN;  
END EXCH;
```



```

/*****
*
* COS$SIN:
* THIS PROCEDURE IS USED TO CALCULATE THE COSINE AND SINE FUNCTIONS
* OF A GIVEN ARGUMENT IN RADIANS.
*
* PARAMETERS:
* - A - POINTER TO A FOUR BYTE VECTOR IN WHICH THE FLOATING POINT REPRESENTATION OF AN ANGLE IN RADIANS IS LOCATED.
*
* - C - POINTER TO A FOUR BYTE VECTOR IN WHICH THE VALUE OF THE COSINE OF THE GIVEN ANGLE, WILL BE PLACED.
*
* - S - POINTER TO A FOUR BYTE VECTOR IN WHICH THE VALUE OF THE SINE OF THE GIVEN ANGLE WILL BE PLACED.
*
*****/
COS$SIN: PROCEDURE (A,C,S) PUBLIC;
    DCL (A,C,S) ADDRESS,
        ANGLE BASED A (4) BYTE,
        COSINE BASED C (4) BYTE,
        SINE BASED S (4) BYTE,
        ANGLE$SQ (4) BYTE,
        TEMP (4) BYTE,
        TEMP0 (4) BYTE,
        TEMP1 (4) BYTE,
        MINUS$ONE (4) BYTE DATA (00H,00H,80H,00FH), /* -1.0 */
        ONE$FLOAT (4) BYTE DATA (00H,00H,80H,3FH), /* 1.0 IN F.P. FORMAT */
        TWO$FLOAT (4) BYTE DATA (00H,00H,00H,40H), /* 2.0 */
        PI$FLOAT (4) BYTE DATA (00EH,0FH,49H,40H), /* 3.141593 */
        TWO$PI (4) BYTE DATA (00EH,0FH,0C9H,40H), /* 6.2831853 */

```



```

PI$OVER2 (4) BYTE DATA (00BH,0FH,0C9H,3FH), /* 1.5707963 */
PI$3$OVER2 (4) BYTE DATA (0E4H,0CBH,96H,40H), /* 4.7123889 */
CONST#1 (4) BYTE DATA (0B5H,1FH,12H,3FH), /* 0.5707963 */
CONST#2 (4) BYTE DATA (0E6H,5DH,25H,0BFH), /* -0.645964 */
CONST#3 (4) BYTE DATA (0E1H,35H,0A3H,3DH), /* 0.079629261 */
CONST#4 (4) BYTE DATA (0AAH,68H,99H,0EBH), /* -0.0046816668 */
CONST#5 (4) BYTE DATA (25H,0BH,28H,39H), /* 0.0001602588 */
CONST#6 (4) BYTE DATA (0A4H,067H,66H,0B6H), /* -0.0000034333 */
CHECK BYTE DATA (002H), /* CHECK FOR GREATER THAN */
CHECK1 BYTE DATA (003H), /* CHECK FOR GREATER THAN OR EQUAL */
CHECK2 BYTE DATA (001H), /* CHECK FOR LESS THAN OR EQUAL */
CHECK3 BYTE DATA (004H), /* CHECK FOR EQUAL */
(SIGN,SIGN1,QUAD,I) BYTE;

DO I = 0 TO 3;
  TEMP0(I) = ANGLE(I);
  SINE(I), COSINE(I) = 00H;
  END;
/* CHECK IF ANGLE IS >= 360 DEGREES. */
SIGN = FCMPCR(TEMP0,,TWO$PI,,CHECK1);
DO WHILE SIGN;
  CALL FSUBC(TEMP0,,TWO$PI,,TEMP0);
  SIGN = FCMPCR(TEMP0,,TWO$PI,,CHECK1);
  END;
/* CHECK IF ANGLE IS NEGATIVE. */
DO WHILE TEMP0(3) >= 080H;
  CALL FADD(TEMP0,,TWO$PI,,TEMP0);
  END;
/* CHECK FOR SPECIAL CASES */
IF FCMPCR(TEMP0,,PI$OVER2,,CHECK3)
  THEN DO; /* 90 DEGREES */

```



```

DO I = 0 TO 3;
  SINE(I) = ONE$FLOAT(I);
END;
RETURN;
END;
IF FCMPR (, TEMPO, .PI#3#OVER2, .CHECK3)
THEN DO; /* 270 DEGREES */
  DO I = 0 TO 3;
    SINE(I) = MINUS$ONE(I);
  END;
  RETURN;
END;
IF FCMPR (, TEMPO, .TWO$PI, .CHECK3)
THEN DO; /* 360 DEGREES */
  DO I = 0 TO 3;
    COSINE(I) = ONE$FLOAT(I);
  END;
  RETURN;
END;
/* TO NORMALIZE THE ANGLE BETWEEN 0 AND 90 DEGREES. */
QUAD = 1;
IF (SIGN := FCMPR(, TEMPO, .PI#OVER2, .CHECK)) AND
(SIGN1 := FCMPR(, TEMPO, .PI#FLOAT, .CHECK2))
THEN DO;
  QUAD = 2;
  CALL FSUB(, PI$FLOAT, .TEMPO, .TEMPO);
END;
ELSE DO;
  IF (SIGN := FCMPR(, TEMPO, .PI$FLOAT, .CHECK)) AND
(SIGN1 := FCMPR(, TEMPO, .PI#3#OVER2, .CHECK2))
THEN DO;

```



```

      QUAD = 3;
      CALL FSUB(.TEMP0,.PI$FLOAT,.TEMP0);
      END;
    ELSE DO;
      IF (SIGN := FCMPR(.TEMP0,.PI$3$OVER2,.CHECK))
      THEN DO;
        QUAD = 4;
        CALL FSUB(.TWO$PI,.TEMP0,.TEMP0);
        END;
      END;
    END;
  /* CONVERT ANGLE IN RADIANS TO ANGLE IN SEMICIRCLE UNITS. */
  CALL FDIY(.TEMP0,.PI$FLOAT,.TEMP);
  /* GET THE SQUARE OF THE ANGLE. */
  CALL FSQR(.TEMP,.ANGLE$SQ);
  /* PERFORM HASTINGS APPROXIMATION. */
  CALL FMUL(.ANGLE$SQ,.CONST$6,.TEMP1);
  CALL FADD(.TEMP1,.CONST$5,.TEMP1);
  CALL FMUL(.ANGLE$SQ,.TEMP1,.TEMP1);
  CALL FADD(.TEMP1,.CONST$4,.TEMP1);
  CALL FMUL(.ANGLE$SQ,.TEMP1,.TEMP1);
  CALL FADD(.TEMP1,.CONST$3,.TEMP1);
  CALL FMUL(.ANGLE$SQ,.TEMP1,.TEMP1);
  CALL FADD(.TEMP1,.CONST$2,.TEMP1);
  CALL FMUL(.ANGLE$SQ,.TEMP1,.TEMP1);
  CALL FADD(.TEMP1,.CONST$1,.TEMP1);
  CALL FMUL(.TEMP,.TEMP1,.TEMP1);
  CALL FADD(.TEMP1,.TEMP,.TEMP1);
  CALL FSQR(.TEMP1,.TEMP1);
  CALL FMUL(.TEMP1,.TWO$FLOAT,.TEMP1);
  /* TO COMPUTE THE VALUE OF THE COSINE. */

```



```

CALL FSUB(.ONE$FLOAT,.TEMP1,.COSINE);
/* TO COMPUTE THE VALUE OF THE SINE. */
CALL FSQR(.COSINE,.TEMP1);
CALL FSUB(.ONE$FLOAT,.TEMP1,.TEMP1);
CALL FSQRT(.TEMP1,.SINE);
/* GIVE SIGNS TO COSINE AND SINE VALUES ACCORDING TO QUADRANT */
DO CASE QUAD;
;
;
COSINE(3) = COSINE(3) XOR 80H; /* FIRST QUADRANT */
/* SECOND QUADRANT */
DO;
COSINE(3) = COSINE(3) XOR 80H; /* THIRD QUADRANT */
SINE(3) = SINE(3) XOR 80H;
END;
SINE(3) = SINE(3) XOR 80H; /* FOURTH QUADRANT */
END;
/* ALL DONE. RETURN */
END COS$SIN;

```



```

/*****
*
* ARC$TAN:
* THIS PROCEDURE IS USED TO CALCULATE THE ARC$TAN FUNCTION IN RADIANS
* GIVEN AS ARGUMENT A RATIO OF TWO VALUES IN FP REPRESENTATION.
*
* PARAMETERS:
* - X - POINTER TO A FOUR BYTE VECTOR REPRESENTING THE DENOMINATOR
*   OF THE RATIO.
* - Y - POINTER TO A FOUR BYTE VECTOR REPRESENTING THE NUMERATOR
*   OF THE RATIO.
* - A - POINTER TO A FOUR BYTE VECTOR IN WHICH THE VALUE OF THE ANGLE
*   (IN RADIANS) WILL BE PLACED AFTER CALCULATION OF THE ARC$TAN.
*
*****/
ARC$TAN: PROCEDURE (X,Y,A) PUBLIC;
    DCL (X,Y,A) ADDRESS,
        DELTA$X BASED X (4) BYTE,
        DELTA$Y BASED Y (4) BYTE,
        ANGLE BASED A (4) BYTE,
        PI$FLOAT (4) BYTE DATA (0DEH,0FH,49H,40H),
        TWO$PI (4) BYTE DATA (0DEH,0FH,0C9H,40H),
        PI$OVER4 (4) BYTE DATA (0DEH,0FH,49H,3FH),
        PI$OVER2 (4) BYTE DATA (0DEH,0FH,0C9H,3FH),
        PI$3$OVER2 (4) BYTE DATA (0E4H,0CEH,96H,40H),
        CONST$1 (4) BYTE DATA (0F5H,0FFH,7FH,3FH),
        CONST$2 (4) BYTE DATA (1CH,0A6H,0AAH,0BEH),
        CONST$3 (4) BYTE DATA (0A7H,40H,4CH,3EH),
        CONST$4 (4) BYTE DATA (63H,6CH,0EH,0BEH),
        CONST$5 (4) BYTE DATA (0DEH,77H,0C5H,3DH),
        CONST$6 (4) BYTE DATA (0C4H,01H,65H,0E0H),
        /* 3.141593 */
        /* 6.2831853 */
        /* 0.78539819 */
        /* 1.5707963 */
        /* 4.7123889 */
        /* 0.99999993329 */
        /* -0.3332985605 */
        /* 0.1994653599 */
        /* -0.1390853351 */
        /* 0.0964200441 */
        /* -0.0559098861 */

```



```

CONST#7 (4) BYTE DATA (51H, 16H, 0E3H, 3CH),          /* 0.002186612288 */
CONST#8 (4) BYTE DATA (0E6H, 0D7H, 84H, 0BEH),        /* -0.0040540580 */
CHECK BYTE DATA (04H),
MSG1(*) BYTE DATA
      (' ARC$TAN FUNCTION UNDEFINED FOR BOTH ARGUMENTS EQUAL TO ZERO. $$'),
MSG2(*) BYTE DATA (' FATAL ERROR. $$'),
Z (4) BYTE,
Z$SQUARE (4) BYTE,
TEMP (4) BYTE,
TEMP1 (4) BYTE,
      (SIGN$, SIGN$Y, ZERO$, ZERO$Y, I) BYTE,
SIGN$, SIGN$Y = 00H;
DO I = 0 TO 3;
  TEMP(I) = DELTA$Y(I);
  TEMP1(I) = DELTA$X(I);
END;

/* SAVE SIGN TO DETERMINE QUADRANT */
IF TEMP(3) >= 80H THEN SIGN$Y = 0FFH;
IF TEMP1(3) >= 80H THEN SIGN$X = 0FFH;
/* CHECK FOR VALID ARGUMENTS */
IF (ZERO$Y := FZTST(.DELTA$Y,.CHECK)) AND
   (ZERO$X := FZTST(.DELTA$X,.CHECK))
THEN DO;
  CALL CRT$PRINT$STRING (.MSG1);
  CALL CRT$PRINT$STRING (.MSG2);
  HALT;
END;
IF ZERO$X
THEN DO;
  IF SIGN$Y
  THEN DO;

```



```

DO I = 0 TO 3;
  ANGLE(I) = PI$3#OVER2(I);
END;
RETURN;
END;
ELSE DO;
  DO I = 0 TO 3;
    ANGLE(I) = PI$OVER2(I);
  END;
  RETURN;
END;
END;

/* FORM 2 TO PERFORM HASTINGS APPROXIMATION */
TEMP(3) = TEMP(3) AND 7FH;
TEMP1(3) = TEMP1(3) AND 7FH;
CALL FSUB(.TEMP, .TEMP1, .Z);
CALL FADD(.TEMP, .TEMP1, .TEMP);
CALL FDIV(.Z, .TEMP, .Z);
CALL FSQR(.Z, .Z$SQUARE);
/* PERFORM HASTINGS APPROXIMATION FOR ARC$TAN */
CALL FMUL(.Z$SQUARE, .CONST$8, .TEMP);
CALL FADD(.TEMP, .CONST$7, .TEMP);
CALL FMUL(.Z$SQUARE, .TEMP, .TEMP);
CALL FADD(.TEMP, .CONST$6, .TEMP);
CALL FMUL(.Z$SQUARE, .TEMP, .TEMP);
CALL FADD(.TEMP, .CONST$5, .TEMP);
CALL FMUL(.Z$SQUARE, .TEMP, .TEMP);
CALL FADD(.TEMP, .CONST$4, .TEMP);
CALL FMUL(.Z$SQUARE, .TEMP, .TEMP);
CALL FADD(.TEMP, .CONST$3, .TEMP);
CALL FMUL(.Z$SQUARE, .TEMP, .TEMP);

```



```

CALL FADD(.TEMP, .CONST$2, .TEMP);
CALL FMUL(.Z$SQUARE, .TEMP, .TEMP);
CALL FADD(.TEMP, .CONST$1, .TEMP);
CALL FMUL(.Z, .TEMP, .TEMP);
CALL FADD(.TEMP, .PI$OVER4, .ANGLE);
/*  RESTORE ANGLE TO PROPER QUADRANT */
IF (NOT SIGN$Y) AND SIGN$X /* SECOND QUADRANT */
    THEN CALL FSUB(.PI$FLOAT, .ANGLE, .ANGLE);
IF SIGN$Y AND SIGN$X /* THIRD QUADRANT */
    THEN CALL FADD(.PI$FLOAT, .ANGLE, .ANGLE);
IF SIGN$Y AND (NOT SIGN$X) /* FOURTH QUADRANT */
    THEN CALL FSUB(.TWO$PI, .ANGLE, .ANGLE);
/*  ALL DONE. RETURN */
END ARC$TAN;

```

END FL0ATING\$POINT;

TIME

TIME

TIME: DO;

CRT\$WRITE:
PROCEDURE (A) EXTERNAL;
DECLARE A BYTE; END;

CRT\$PRINT\$STRING:
PROCEDURE (A) EXTERNAL;
DECLARE A ADDRESS; END;

ECHO\$CRT:
PROCEDURE BYTE EXTERNAL;
END;

SEND\$BEL:
PROCEDURE EXTERNAL;
END;

SEND\$CR:
PROCEDURE EXTERNAL;
END;

SEND\$CRLF:
PROCEDURE EXTERNAL;
END;

SEND\$SUB:
PROCEDURE EXTERNAL;
END;


```
GET$BYTE:
  PROCEDURE (A) BYTE EXTERNAL;
  DECLARE A BYTE; END;

CHECK$INPUT:
  PROCEDURE BYTE EXTERNAL;
  END;

CLEAR$LOW$SCREEN:
  PROCEDURE EXTERNAL;
  END;

DECLARE (MILI$SEC, DUMMY$SEC, SECONDS, MINUTES, HOURS, DAY, SEC$TIME) BYTE PUBLIC;
TIME$STEP ADDRESS PUBLIC;
TIME$BUFFER(6) BYTE PUBLIC;
```



```

*****
*
* CLOCK:
* THIS PROCEDURE IS OF THE TYPE INTERRUPT. IT IS USED TO MAINTAIN A REAL
* TIME HOUR, ONCE INITIATED. IT USES THE MDS REAL TIME CLOCK.
*
* USAGE:
* THIS PROCEDURE IS CALLED EACH TIME AN INTERRUPT FROM THE REAL TIME CLOCK
* IN THE MDS SYSTEM, IS PRODUCED.
*
* *** WARNING ***
* SINCE THE DEVELOPMENT OF THIS PROCEDURE WAS DONE UNDER ISIS, THE PROCEDURE
* HAD TO BE DECLARED AS INTERRUPT 7, SINCE ISIS DOES NOT ALLOW FOR INTERRUPTS
* LESS THAN OR EQUAL TO 2. THE INTERRUPT FROM THE REAL TIME CLOCK IS OF LEVEL
* 1, AND THEREFORE, A 'CALL MOVE' INSTRUCTION HAD TO BE IMPLEMENTED, IN
* ORDER TO MOVE THE CODE IN INT 7 TO INT 1 AND PASS OVER THIS ISIS INCONVENIEN-
* CE. IF A COPY OF THIS PROGRAM IS TO BE EXECUTED WITHOUT ISIS, THEN THIS PRO-
* CEDURE MUST BE RECOMPILED AS PROCEDURE INTERRUPT 1, AND THE 'CALL MOVE' STA-
* TEMENT IN THE INITIATE$CLOCK PROCEDURE, REMOVED.
*
*****
CLOCK: PROCEDURE INTERRUPT 7;
  DECLARE TEMP BYTE;
/* TO RESET THE MDS REAL TIME CLOCK. */
  OUTPUT(0FFH) = 03H;
  MILI$SEC = MILI$SEC + 1;
  IF MILI$SEC = 128 THEN DO;
    MILI$SEC = 0;
    DUMMY$SEC = DUMMY$SEC + 1;
  END;
  IF DUMMY$SEC = 08H THEN DO;

```



```

NILI$SEC, DUMMY$SEC = 0;
SEC$TIME = 0FFH;          /* BOOLEAN VARIABLE. A SECOND HAS ELAPSED. */
SECONDS = SECONDS + 1;
TIME$STEP = TIME$STEP + 1;
IF SECONDS = 60 THEN DO;
  SECONDS = 00;
  MINUTES = MINUTES + 1;
  IF MINUTES = 60 THEN DO;
    MINUTES = 00;
    HOURS = HOURS + 1;
    IF HOURS = 24 THEN DO;
      HOURS = 00;
      DAY = 1;
    END;
  END;
END;

/* DISABLE INTERRUPTS. */
DISABLE;
/* RESTORE CURRENT OPERATING LEVEL. */
OUTPUT(0FDH) = 020H;
/* SET THE MDS REAL TIME CLOCK. */
TEMP = INPUT(0FFH);
TEMP = INPUT(0FFH);
OUTPUT(0FFH) = 00H;
/* THE RETURN STATEMENT WILL ENABLE INTERRUPTS AUTOMATICALLY. */
RETURN;
END CLOCK;

```



```

/*****
*
* INITIATE$TIME:
* PROCEDURE USED DURING SYSTEM INITIALIZATION. USED TO SET THE SIMULATED
* REAL TIME CLOCK TO AN SPECIFIED HOUR.
*
* USAGE:
* UTILIZES THE GLOBAL VARIABLES HOURS, MINUTES AND SECONDS.
*
*****/
INITIATE$TIME: PROCEDURE PUBLIC;
  DECLARE OK BYTE;
  DECLARE MSG(*) BYTE DATA (' *** BAD FORMAT. ***$'$');
  OK = 0;
  DO WHILE OK = 0;
    HOURS, MINUTES, SECONDS = 0FFH;
    CALL CRT$PRINT$STRING('INPUT THE TIME AS REQUESTED. $$');
    CALL SEND$CRLF;
    DO WHILE HOURS >= 24;
      CALL CRT$PRINT$STRING('HOURS: $$');
      HOURS = GET$BYTE(2);
      IF HOURS >= 24
      THEN DO;
        CALL CRT$PRINT$STRING(.MSG);
        CALL SEND$BEL;
        CALL SEND$CR;
        CALL SEND$SUB;
        END;
      ELSE DO;
        CALL CRT$WRITE(17H); /* ERASE TO END OF LINE */
        CALL SEND$CRLF;
      END;
    END;
  END;

```



```

END;
END;
DO WHILE MINUTES >= 60;
  CALL CRT$PRINT$STRING(,('MINUTES: $$'));
  MINUTES = GET$BYTE(2);
  IF MINUTES >= 60
  THEN DO;
    CALL CRT$PRINT$STRING(, MSG);
    CALL SEND$BEL;
    CALL SEND$CR;
    CALL SEND$SUB;
  END;
ELSE DO;
  CALL CRT$WRITE(17H);
  CALL SEND$CRLF;
END;
/* ERASE TO END OF LINE */

END;
DO WHILE SECONDS >= 60;
  CALL CRT$PRINT$STRING(,('SECONDS: $$'));
  SECONDS = GET$BYTE(2);
  IF SECONDS >= 60
  THEN DO;
    CALL CRT$PRINT$STRING(, MSG);
    CALL SEND$BEL;
    CALL SEND$CR;
    CALL SEND$SUB;
  END;
ELSE DO;
  CALL CRT$WRITE(17H);
  CALL SEND$CRLF;
END;
/* ERASE TO END OF LINE */

```


TIME

INITIATE\$TIME

```
END;  
OK = CHECK$INPUT;  
CALL CLEAR$LOW$SCREEN;  
END;  
END INITIATE$TIME;
```



```

/*****
*
* INITIATE$CLOCK:
*   PROCEDURE USED TO START THE SIMULATED REAL TIME CLOCK.
*
* *****/
INITIATE$CLOCK: PROCEDURE PUBLIC;
  MILLI$SEC, DUMMY$SEC = 00;
/*
*   *** WARNING ***
*   THE FOLLOWING STATEMENT SHOULD BE REMOVED IF THIS MODULE IS TO BE
*   EXECUTED WITHOUT ISIS. THE CLOCK PROCEDURE SHOULD ALSO BE RECOMPI-
*   LED AS PROCEDURE INTERRUPT 1.
*
* */
  CALL MOVE (3, 038H, 008H);
  OUTPUT(0FDH) = 12H;
  OUTPUT(0FCH) = 00H;
  ENABLE;
  OUTPUT(0FFH) = 00H;
  END INITIATE$CLOCK;

```


TIME

ACTUAL\$TIME

```

/*****
*
* ACTUAL$TIME:
* PROCEDURE USED TO PUT INTO THE VECTOR 'TIME$BUFFER', THE ACTUAL
* TIME IN A STRING FORM.
*
*****/
ACTUAL$TIME: PROCEDURE PUBLIC;
TIME$BUFFER(0) = HOURS/10 + 30H;
TIME$BUFFER(1) = HOURS MOD 10 + 30H;
TIME$BUFFER(2) = MINUTES/10 + 30H;
TIME$BUFFER(3) = MINUTES MOD 10 + 30H;
TIME$BUFFER(4) = SECONDS/10 + 30H;
TIME$BUFFER(5) = SECONDS MOD 10 + 30H;
END ACTUAL$TIME;

END TIME;

```


PLASMA\$PRIMITIVES: DO;

DECLARE LIT LITERALLY 'LITERALLY',
DCL LIT 'DECLARE';

DCL TRUE LIT '0FFH',
FALSE LIT '00H';

DCL PLASMA\$DATA LIT '04H',
PLASMA\$STATUS LIT '05H',
RECEIVE\$MASK LIT '06H',
TRANSMIT\$MASK LIT '05H';

DCL STATUS\$A LIT '04H',
RESET\$ALL LIT '00H',
OUT\$BUSY LIT '01H',
IN\$BUSY LIT '02H';

DCL STX LIT '02H',
ETX LIT '03H',
CS LIT '0CH',
CG LIT '0EH',
CV LIT '0FH',
EOL LIT '24H';
/* START TEXT */
/* ENABLE TEXT */
/* CLEAR SCREEN */
/* CONSTRUCT GRAPH */
/* CLEAR VECTORS */
/* END OF LINE */


```

DCL SET$ERASE      LIT '0100#000000',
SET$DASHED         LIT '0001#000000',
SET$END            LIT '0010#000000';
    
```



```

/*****
*
* SET#STATUS#PLASMA:
*   THIS PROCEDURE IS USED TO SET THE STATUS LINE FOR THE PLASMA.
*   NOTE THAT THE LOGIC TO BE USED IS NEGATIVE.
*
* PARAMETERS:
*   - STATUS. - ASCII CHARACTER USED TO DEFINE THE STATUS LINE.
*
*****/
SET#STATUS#PLASMA: PROCEDURE (STATUS) PUBLIC;
  DCL STATUS BYTE;
  OUTPUT(PLASMA#STATUS) = NOT STATUS;
  END SET#STATUS#PLASMA;

```



```

/*****
*
* PLASMA$WRITE:
* THIS PROCEDURE IS USED TO SEND A CHARACTER TO THE PLASMA DISPLAY.
*
* PARAMETERS:
* - CHAR. - ASCII CHARACTER DESIRED TO BE SENT.
*
*****/
PLASMA$WRITE: PROCEDURE (CHAR) PUBLIC;
DECL CHAR BYTE;
DO WHILE ((NOT INPUT(PLASMA$STATUS)) AND STATUS#A) <> STATUS#A;
  END; /* WAIT FOR PLASMA TO BE READY */
CALL SET$STATUS$PLASMA(RESET$ALL);
OUTPUT(PLASMA$DATA) = NOT CHAR;
CALL SET$STATUS$PLASMA(OUT$BUSY);
END PLASMA$WRITE;

```



```
/******  
* CLEAR$PLASMA:  
* THIS PROCEDURE IS USED TO CLEAR THE PLASMA DISPLAY.  
*  
*****/  
CLEAR$PLASMA: PROCEDURE PUBLIC;  
  CALL SET$STATUS$PLASMA(IN$BUSY);  
  CALL SET$STATUS$PLASMA(RESET$ALL);  
  CALL PLASMA$WRITE(CS);  
  CALL PLASMA$WRITE(CV);  
  CALL SET$STATUS$PLASMA(RESET$ALL);  
  END CLEAR$PLASMA;
```



```

/*****
*
* PLASMA$WRITE$VECTOR:
* THIS PROCEDURE IS USED TO SEND A FOUR BYTE VECTOR TO THE PLASMA.
*
* PARAMETERS:
* - A - POINTER TO THE FOUR BYTE VECTOR DESIRED TO BE SENT.
*
*****/
PLASMA$WRITE$VECTOR: PROCEDURE (A) PUBLIC;
  DCL A ADDRESS,
        VECTOR BASED A (4) BYTE,
        VPTR BYTE;
  DO VPTR = 0 TO 3;
    CALL PLASMA$WRITE(VECTOR(VPTR));
  END;
END PLASMA$WRITE$VECTOR;

```



```

/*****
*
* PLASMA$PRINT$STRING:
* THIS PROCEDURE IS USED TO WRITE A GIVEN STRING IN A GIVEN POSITION AT
* THE PLASMA DISPLAY.
*
* PARAMETERS:
* - COLUMN - DENOTES THE COLUMN NUMBER DESIRED TO BE ADDRESSED.
* - ROW - DENOTES THE ROW NUMBER DESIRED TO BE ADDRESSED.
* - POINTER - POINTS TO THE FIRST BYTE OF THE STRING DESIRED TO BE DIS-
* PLAYED. NOTE THAT TWO CONSECUTIVE '$' SIGNS MUST MARK THE END OF
* THE STRING.
*
*****/
PLASMA$PRINT$STRING: PROCEDURE (COLUMN, ROW, POINTER) PUBLIC;
DCL POINTER ADDRESS,
    BUFFER BASED POINTER (1) BYTE,
    (COLUMN, ROW, COUNT) BYTE;
COUNT = 0;
CALL SET$STATUS$PLASMA(IN$BUSY);
CALL SET$STATUS$PLASMA(RESET$ALL);
CALL PLASMA$WRITE(STX);
CALL PLASMA$WRITE(COLUMN);
CALL PLASMA$WRITE(ROW);
DO WHILE (BUFFER(COUNT) <> EOL ) OR (BUFFER(COUNT + 1) <> EOL )
    CALL PLASMA$WRITE(BUFFER(COUNT));
    COUNT = COUNT + 1;
END;
CALL PLASMA$WRITE(ETX);
CALL SET$STATUS$PLASMA(RESET$ALL);
END PLASMA$PRINT$STRING;

```



```
*****  
*  
* INITIALIZE$PLASMA:  
* THIS PROCEDURE IS USED TO INITIALIZE THE PLASMA DISPLAY.  
*  
*****/  
INITIALIZE$PLASMA: PROCEDURE PUBLIC;  
  DCL BUFFER (*) BYTE DATA ('ON LINE. $$');  
  CALL CLEAR$PLASMA;  
  CALL PLASMA$PRINT$STRING(0, 2, .BUFFER);  
  END INITIALIZE$PLASMA;
```



```

/*****
*
* SET$VECTOR:
* THIS PROCEDURE IS USED PREPARE TWO X AND Y VALUES GIVEN INTO THE FOR-
* MAT REQUIRED BY THE PLASMA UNIT TO DEFINE A VECTOR.
* PARAMETERS:
*   - X. - ADDRESS VALUE.
*   - Y. - ADDRESS VALUE.
*   - POINTER. - POINTS TO A FOUR BYTE VECTOR IN WHICH THE X AND Y VALUES
*   WILL BE ARRANGED.
*
*****/
SET$VECTOR: PROCEDURE (X, Y, POINTER) PUBLIC;
  DCL (X, Y, POINTER) ADDRESS,
    VECTOR BASED POINTER (4) BYTE;
  VECTOR(0) = CG;
  VECTOR(1), VECTOR(2), VECTOR(3) = 00H;
  VECTOR(1) = LOW(X) AND 07FH;
  VECTOR(2) = LOW(Y) AND 07FH;
  VECTOR(3) = HIGH(SHL(Y AND 100H, 3)) OR
    HIGH(SHL(X AND 100H, 1));
  VECTOR(3) = VECTOR(3) AND NOT SET$ERASE;
END SET$VECTOR;

```



```

/*****
*
* START$VECTOR$SOLID:
* THIS PROCEDURE IS USED TO DEFINE A START POINT FOR A SOLID VECTOR.
*
* PARAMETERS:
* - X. - ADDRESS VALUE.
* - Y. - ADDRESS VALUE.
*
*****/
START$VECTOR$SOLID: PROCEDURE (X, Y) PUBLIC;
    DCL (X, Y) ADDRESS,
        VECTOR (4) BYTE;
    CALL SET$VECTOR(X, Y, VECTOR);
    VECTOR(3) = VECTOR(3) AND NOT SET$DASHED;
    VECTOR(3) = VECTOR(3) AND NOT SET$END;
    CALL PLASMA$WRITE$VECTOR(. VECTOR);
    END START$VECTOR$SOLID;

```



```

/*****
*
* STOP$VECTOR$SOLID:
* THIS PROCEDURE IS USED TO DEFINE A STOP POINT FOR A SOLID VECTOR.
*
* PARAMETERS:
*   - X. - ADDRESS VALUE.
*   - Y. - ADDRESS VALUE.
*
*****/
STOP$VECTOR$SOLID: PROCEDURE (X, Y) PUBLIC;
  DCL (X, Y) ADDRESS,
      VECTOR (4) BYTE;
  CALL SET$VECTOR(X, Y, VECTOR);
  VECTOR(3) = VECTOR(3) AND NOT SET$DASHED;
  VECTOR(3) = VECTOR(3) OR SET$END;
  CALL PLASMA$WRITE$VECTOR(VECTOR);
  END STOP$VECTOR$SOLID;

```



```

/*****
*
* START$VECTOR$DASH:
* THIS PROCEDURE IS USED TO DEFINE A START POINT FOR A DASHED VECTOR.
*
* PARAMETERS:
*   - X. - ADDRESS VALUE.
*   - Y. - ADDRESS VALUE.
*
* *****/
START$VECTOR$DASH: PROCEDURE (X, Y) PUBLIC;
    DCL (X, Y) ADDRESS,
        VECTOR (4) BYTE;
    CALL SET$VECTOR(X, Y, VECTOR);
    VECTOR(3) = VECTOR(3) OR SET$DASHED;
    VECTOR(3) = VECTOR(3) AND NOT SET$END;
    CALL PLASMA$WRITE$VECTOR(. VECTOR);
    END START$VECTOR$DASH;

```



```

/*****
*
* STOP$VECTOR$DASH:
* THIS PROCEDURE IS USED TO DEFINE A STOP POINT FOR A DASHED VECTOR.
*
* PARAMETERS:
* - X. - ADDRESS VALUE.
* - Y. - ADDRESS VALUE.
*
*****/
STOP$VECTOR$DASH: PROCEDURE (X, Y) PUBLIC;
    DCL (X, Y) ADDRESS,
        VECTOR (4) BYTE;
    CALL SET$VECTOR(X, Y, VECTOR);
    VECTOR(3) = VECTOR(3) OR SET$DASHED;
    VECTOR(3) = VECTOR(3) OR SET$END;
    CALL PLASMA$WRITE$VECTOR(. VECTOR);
    END STOP$VECTOR$DASH;

```



```

/*****
*
* GRAPHIC#DESIG:
* THIS PROCEDURE IS USED TO DISPLAY THE DESIGNATION OF A CONTACT IN THE
* NEAREST POSSIBLE ALPHANUMERIC LOCATION TO THE X, Y VALUES GIVEN.
*
* PARAMETERS:
* - X - ADDRESS VALUE.
* - Y - ADDRESS VALUE.
* - DESIG - POINTER TO THE DESIG OF A CONTACT.
*
*****/
GRAPHIC#DESIG: PROCEDURE (X, Y, DESIG) PUBLIC;
  DCL (X, Y, DESIG) ADDRESS,
    VALUE BASED DESIG ADDRESS,
    BUFFER (6) BYTE,
    (ROW, COLUMN) BYTE;
  BUFFER(0) = 'I';
  BUFFER(1) = VALUE / 100;
  BUFFER(2) = VALUE MOD 100;
  BUFFER(3) = 'J';
  BUFFER(4), BUFFER(5) = EOL;
  ROW = Y / 16;
  COLUMN = (X - 14) / 6 - 5;
  IF X <= 8 THEN COLUMN = 0;
  IF (X >= 9) AND (X <= 44) THEN COLUMN = X / 6;
  IF (X >= 494) THEN COLUMN = 75;
  CALL PLASMA#PRINT$STRING(COLUMN, ROW, .BUFFER);
  END GRAPHIC#DESIG;

```


PLASMA#PRIMITIVES

GRAPHIC#DESIG

END PLASMA#PRIMITIVES


```

BASICS: DO;

DECLARE LIT LITERALLY 'LITERALLY',
      DCL LIT 'DECLARE';
DCL CR LIT '0DH',
      LF LIT '0AH',
      EOL LIT '24H',
      BS LIT '08H',
      SPACE LIT '20H',
      RUB LIT '7FH',
      SUB LIT '1AH',
      BEL LIT '07H';

DCL TRUE LIT '0FFH',
      FALSE LIT '00H',
      FOREVER LIT 'WHILE TRUE';

DCL CRTDATA LIT '0F6H',
      CRTSTATUS LIT '0F7H',
      CRT#REC#MASK LIT '06H',
      CRT#TRT#MASK LIT '05H';

      /* CARRIAGE RETURN. */
      /* LINE FEED. */
      /* $$ INDICATES END OF LINE. */
      /* BACKSPACE. */
      /* SPACE. */
      /* RUB OUT. */
      /* UP ROW CURSOR. */
      /* RING THE BELL. */

      /* CRT DATA ON PORT 246. */
      /* CRT STATUS ON PORT 247. */
      /* MASK FOR CRT: RECEIVE. */
      /* MASK FOR CRT: TRANSMIT. */

```



```

/*****
*
* CRT$WRITE:
*   PROCEDURE USED TO SEND A CHARACTER TO THE CRT.
*
* PARAMETERS:
*   - CHAR. -CHARACTER BYTE TO BE SENT.
*
*****/
CRT$WRITE: PROCEDURE (CHAR) PUBLIC;
  DCL CHAR BYTE;
  DO WHILE (INPUT(CRTSTATUS) AND CRT$TRT$MASK) <> CRT$TRT$MASK / *WAIT*/
  END;
  OUTPUT(CRTDATA) = CHAR;
  END CRT$WRITE;

```



```

/*****
*
* CRT$PRINT$STRING:
*   PROCEDURE USED TO SEND A STRING OF CHARACTERS TO THE CRT.
*
* PARAMETERS:
*   - A - POINTER TO STRING. $$ WILL INDICATE END OF STRING. MAXIMUM
*     LENGTH: 80 CHARACTERS.
*
*****/
CRT$PRINT$STRING: PROCEDURE (A) PUBLIC;
  DCL (POINTER,A) ADDRESS,
        (BUFFER BASED A) (80) BYTE;
  POINTER = 0;
  DO WHILE (BUFFER(POINTER) <> EOL) OR (BUFFER(POINTER + 1) <> EOL);
    CALL CRT$WRITE(BUFFER(POINTER));
    POINTER = POINTER + 1;
  END;
END CRT$PRINT$STRING;

```



```

/*****
*
* CRT$READ:
*   PROCEDURE USED TO RECEIVE A CHARACTER FROM THE CRT, AND RETURN ITS
*   VALUE TO THE CALLING MODULE.
*
* USAGE:
*   UNTYPED PROCEDURE. RETURNS A BYTE VALUE. (ASCII CODE)
*
*****/
CRT$READ: PROCEDURE BYTE PUBLIC;
  DCL CHAR BYTE;
  DO WHILE (INPUT(CRT$STATUS) AND CRT$REC$MASK) <> CRT$REC$MASK /WAIT*/
    END;
  CHAR = INPUT(CRT$DATA);
  IF CHAR >= 80H THEN CHAR = CHAR XOR 80H;
  RETURN CHAR;
END CRT$READ;

```



```

/*****
*
* CRT$TRY$READ:
*   PROCEDURE USED TO TEST IF CHARACTER HAS BEEN SENT FROM CRT.
*
* USAGE:
*   TYPED PROCEDURE. IF READING WAS SUCCESSFUL, ( A KEY WAS DEPRESSED )
*   THEN THE BYTE VALUE OF THE ASCII CHARACTER WILL BE RETURNED. NOTICE
*   THAT NO CHARACTER WILL BE DISPLAYED.
*   IF READING WAS NOT SUCCESSFUL, THEN A NUL ASCII CHARACTER (00H) IS
*   RETURNED, AND NO CHARACTER IS DISPLAYED.
*
*****/
CRT$TRY$READ: PROCEDURE BYTE PUBLIC;
    DCL CHAR BYTE;
    CHAR = 00H;
    IF (INPUT(CRT$STATUS) AND CRT$REC$MASK) = CRT$REC$MASK
        THEN CHAR = INPUT(CRT$DATA);
    IF CHAR >= 80H THEN CHAR = CHAR XOR 80H;
    RETURN CHAR;
END CRT$TRY$READ;

```



```
/******  
* ECHO$CRT:  
* PROCEDURE USED TO RECEIVE AN ASCII CHARACTER FROM THE CRT, DISPLAY  
* THE SAME, AND RETURN ITS BYTE VALUE TO THE CALLING MODULE.  
*  
* USAGE:  
* UNTPED PROCEDURE. RETURNS A BYTE VALUE. (ASCII CODE.)  
*  
*****/  
ECHO$CRT: PROCEDURE BYTE PUBLIC;  
    DCL CHAR BYTE;  
    CHAR = CRT$READ;  
    CALL CRT$WRITE(CHAR);  
    RETURN CHAR;  
END ECHO$CRT;
```


BASICS

SEND\$SUB

```
/******  
*  
* SEND$SUB:  
* PROCEDURE USED TO SEND AN UP ROW CURSOR CHARACTER TO THE CRT.  
*  
*****/  
SEND$SUB: PROCEDURE PUBLIC;  
  CALL CRT$WRITE(SUB);  
  END SEND$SUB;
```


BASICS

SEND\$CR

```
/******  
* SEND$CR:  
* PROCEDURE USED TO SEND A CR ASCII CHARACTER TO THE CRT.  
*  
*****/  
SEND$CR: PROCEDURE PUBLIC;  
  CALL CRT$WRITE(CR);  
  END SEND$CR;
```


BASICS

SEND\$LF

```
/******  
*  
* SEND$LF:  
* PROCEDURE USED TO SEND A LF ASCII CHARACTER TO THE CRT.  
*  
*****/  
SEND$LF: PROCEDURE PUBLIC;  
  CALL CRT$WRITE(LF);  
  END SEND$LF;
```


BASICS

SEND\$CRLF

```

/*****
*
* SEND$CRLF:
*   PROCEDURE USED TO SEND BOTH CR AND LF ASCII CHARACTERS TO CRT.
*
*****/
SEND$CRLF: PROCEDURE PUBLIC;
    CALL CRT$WRITE(CR);
    CALL CRT$WRITE(LF);
END SEND$CRLF;
```



```
/'*****  
* SEND$BEL;  
*   PROCEDURE USED TO SEND A 'BELL' ASCII CHARACTER TO THE CRT.  
*  
*****/  
SEND$BEL: PROCEDURE PUBLIC;  
  CALL CRT$WRITE(BEL);  
  END SEND$BEL;
```



```
/******  
* SEND$BS:  
* PROCEDURE USED TO SEND A NON-DESTRUCTIVE BACKSPACE CHARACTER TO  
* THE CRT.  
*  
*****  
SEND$BS: PROCEDURE PUBLIC;  
  CALL CRT$WRITE(BS);  
END SEND$BS;
```



```
/******  
* SEND$SPACE:  
*   THIS PROCEDURE IS USED TO SEND SPACES TO THE CRT.  
*  
* PARAMETERS:  
*   - NUM. - NUMBER OF SPACES DESIRED.  
*  
*****  
SEND$SPACE: PROCEDURE (NUM) PUBLIC  
  DCL NUM BYTE;  
  DO WHILE NUM > 0;  
    CALL CRT$WRITE(SPACE);  
    NUM = NUM - 1;  
  END;  
END SEND$SPACE;
```



```

/*****
*
* BYTE$CHAR:
*   PROCEDURE USED TO DISPLAY THE DECIMAL VALUE OF A BYTE VARIA-
*   BLE.
*
* PARAMETERS:
*   - CHAR. - BYTE VALUE DESIRED TO BE DISPLAYED.
*
*****/
BYTE$CHAR: PROCEDURE (CHAR) PUBLIC;
  DCL VALUE(3) BYTE DATA (100,10,1);
  DCL (I,CHAR,COUNT,TEMP) BYTE;
  DO I = 0 TO LAST(VALUE);
    COUNT = 0;
    TEMP = VALUE(I);
    DO WHILE CHAR >= TEMP;
      CHAR = CHAR - TEMP;
      COUNT = COUNT + 1;
    END;
    CALL CRT$WRITE(COUNT + '0');
  END;
END BYTE$CHAR;
```



```

/*****
*
* ADDRESS$CHAR:
* PROCEDURE USED TO DISPLAY THE DECIMAL VALUE OF AN ADDRESS
* VARIABLE.
*
* PARAMETERS:
* - CHAR. - ADDRESS VALUE DESIRED TO BE DISPLAYED.
*
*****/
ADDRESS$CHAR: PROCEDURE (CHAR) PUBLIC;
  DCL VALUE(5) ADDRESS DATA (10000,1000,100,10,1);
  DCL (I,COUNT) BYTE,
        (CHAR,TEMP) ADDRESS;
  DO I = 0 TO LAST(VALUE);
    COUNT = 0;
    TEMP = VALUE(I);
    DO WHILE CHAR >= TEMP;
      CHAR = CHAR - TEMP;
      COUNT = COUNT + 1;
    END;
    CALL CRT$WRITE(COUNT + '0');
  END;
END ADDRESS$CHAR;

```



```

/*****
*
* BYTE$TO$ASCII:
*   THIS PROCEDURE IS USED TO CONVERT A BYTE QUANTITY INTO TWO ASCII
*   CHARACTERS REPRESENTING ITS HEXADECIMAL VALUE.
*
* PARAMETERS:
*   - A - POINTER TO THE BYTE QUANTITY DESIRED TO BE CONVERTED.
*   - B,C - POINTERS TO TWO BYTE QUANTITIES IN WHICH THE TWO ASCII
*           CHARACTERS WILL BE PLACED. B POINTS TO THE MOST SIGNIFICANT
*           PORTION OF THE ANSWER.
*
*****/
BYTE$TO$ASCII: PROCEDURE (A,B,C) PUBLIC;
    DCL (A,B,C) ADDRESS,
        ENTRY BASED A BYTE,
        OUT1 BASED B BYTE,
        OUT2 BASED C BYTE,
        TEMP BYTE;
    TEMP = SHR(ENTRY,4);
    IF TEMP <= 9 THEN OUT1 = TEMP + 30H;
        ELSE OUT1 = TEMP + 37H;
    TEMP = ENTRY AND 00FH;
    IF TEMP <= 9 THEN OUT2 = TEMP + 30H;
        ELSE OUT2 = TEMP + 37H;
    END BYTE$TO$ASCII;

```



```

/*****
*
* GET$BYTE:
*   PROCEDURE USED TO OBTAIN A DECIMAL NUMBER BETWEEN 0 AND 255 FROM
*   THE CRT.
*
* PARAMETERS:
*   - DIGITS - INDICATES THE NUMBER OF DIGITS DESIRED. MUST BE LESS THAN
*   OR EQUAL TO 3, ALTHOUGH NO CHECK OF THIS IS MADE.
*
* USAGE:
*   TYPED PROCEDURE THAT WILL RETURN A DECIMAL DIGIT OBTAINED FROM
*   THE CRT AND REPRESENTABLE IN 3 OR LESS DIGITS.
*   THE VALUE RETURNED WILL ALWAYS BE LESS THAN 255.
*
*****/
GET$BYTE: PROCEDURE(DIGITS) BYTE PUBLIC;
  DCL (NUMBER,DIGITS,CHAR,COUNT) BYTE;
  NUMBER, COUNT = 0;
  DO WHILE DIGITS > 0;
    CHAR = CRT$READ;
    DO WHILE ((CHAR < '0') OR (CHAR > '9')) AND (CHAR <> RUB) OR
      ((CHAR = RUB) AND (COUNT = 0));
    CALL SEND$BEL;
    CHAR = CRT$READ;
  END;
  IF CHAR <> RUB
  THEN DO;
    CALL CRT$WRITE (CHAR);
    NUMBER = NUMBER*10 + (CHAR - 30H);
    COUNT = COUNT + 1;
  END;

```



```
    DIGITS = DIGITS + 1;
  END;
ELSE DO;
  NUMBER = NUMBER/10;
  CALL SEND$BS;
  COUNT = COUNT + 1;
  DIGITS = DIGITS + 1;
END;
END;
RETURN NUMBER;
END GET$BYTE;
```



```

/*****
*
* GET$ADDRESS:
* PROCEDURE USED TO OBTAIN A DECIMAL NUMBER BETWEEN 0 AND 65535 FROM
* THE CRT.
*
* PARAMETERS:
* - DIGITS. - INDICATES THE NUMBER OF DIGITS DESIRED. MUST BE LESS THAN
* OR EQUAL TO 5, ALTHOUGH NO CHECK OF THIS IS MADE.
*
* USAGE:
* TYPED PROCEDURE THAT WILL RETURN A DECIMAL VALUE OBTAINED FROM THE
* CRT AND REPRESENTABLE IN 5 OR LESS DIGITS. THE VALUE RETURNED WILL
* ALWAYS BE LESS THAN 65536.
*
*****/
GET$ADDRESS: PROCEDURE(DIGITS) ADDRESS PUBLIC;
    DCL (CHAR, DIGITS, COUNT) BYTE,
        NUMBER ADDRESS;
    NUMBER, COUNT = 0;
    DO WHILE DIGITS > 0;
        CHAR = CRT$READ;
        DO WHILE ((CHAR < '0') OR (CHAR > '9')) AND (CHAR <> RUB) OR
            ((CHAR = RUB) AND (COUNT = 0));
            CALL SEND$EEL;
            CHAR = CRT$READ;
        END;
        IF CHAR <> RUB
            THEN DO;
                CALL CRT$WRITE(CHAR);
                NUMBER = NUMBER*10 + (CHAR - 30H);
            END;
    END;

```



```
    COUNT = COUNT + 1;
    DIGITS = DIGITS - 1;
    END;
ELSE DO;
    CALL SEND$BS;
    NUMBER = NUMBER/10;
    COUNT = COUNT - 1;
    DIGITS = DIGITS + 1;
    END;
END;
RETURN NUMBER;
END GET$ADDRESS;
```



```

/*****
*
* GET$STRING:
* PROCEDURE USED TO OBTAIN A STRING OF 'NUMBER' CHARACTERS FROM THE
* CRT.
*
* PARAMETERS:
* - NUMBER - NUMBER OF CHARACTERS DESIRED.
* - A - POINTER TO A MEMORY LOCATION IN WHICH THE STRING IS DESIRED
* TO BE PLACED.
*
* USAGE:
* UNTYPED PROCEDURE. THE ONLY CHARACTERS THAT CAN BE ACCEPTED FROM
* THE CRT ARE: NUMBERS, UPPER AND LOWER CASE ALPHABETICS, ALTHOUGH
* ALL LOWER CASE ALPHABETICS WILL BE CONVERTED INTO UPPER CASE.
*
*****/
GET$STRING: PROCEDURE(A, NUMBER) PUBLIC
    DCL A ADDRESS,
        <CHAR BASED A, TEMP, NUMBER, COUNT> BYTE;
    COUNT = 0;
    DO WHILE NUMBER > 0;
        CHAR = CRT$READ;
        DO WHILE (<<CHAR < 30H> OR <CHAR > 7AH> OR <<CHAR > 39H> AND <CHAR < 41H>>)
            OR <<CHAR > 5AH> AND <CHAR < 61H>>) AND <CHAR <> RUB>) OR
            <<CHAR = RUB> AND <COUNT = 0>);
            CALL SEND$BELL;
            CHAR = CRT$READ;
        END;
        IF <CHAR >= 61H> AND <CHAR <= 7AH>
            THEN CHAR = CHAR - 20H;

```



```
IF CHAR <> RUE
THEN DO:
  CALL CRT$WRITE (CHAR);
  A = A + 1;
  NUMBER = NUMBER - 1;
  COUNT = COUNT + 1;
END;
ELSE DO:
  CALL SEND$ES;
  A = A - 1;
  NUMBER = NUMBER + 1;
  COUNT = COUNT - 1;
END;
END;
END GET$STRING;
```



```

/*****
*
* PUT$NUMBER$BUFFER:
* THIS PROCEDURE IS USED TO OBTAIN AN SPECIFIED NUMBER OF NUMERIC CHARACTERS
* FROM THE CRT, AND TO PUT THEM IN A GIVEN MEMORY LOCATION.
*
* PARAMETERS:
* - NUM. - NUMBER OF NUMERIC CHARACTERS DESIRED.
* - A. - POINTER TO A MEMORY LOCATION IN WHICH THE STRING IS DESIRED TO
* BE PLACED.
*
*****/
PUT$NUMBER$BUFFER: PROCEDURE(NUM,A) PUBLIC
DECL A ADDRESS,
      (TEMP BASED A, NUM, CHAR, COUNT) BYTE;
COUNT = 0;
DO WHILE NUM > 0;
  CHAR = CRT$READ;
  DO WHILE ((CHAR < '0') OR (CHAR > '9')) AND (CHAR <> RUB) OR
    ((CHAR = RUB) AND (COUNT = 0));
    CALL SEND$BEL;
    CHAR = CRT$READ;
  END;
  IF CHAR <> RUB
  THEN DO;
    CALL CRT$WRITE(CHAR);
    TEMP = CHAR;
    A = A + 1;
    NUM = NUM - 1;
    COUNT = COUNT + 1;
  END;
END;

```


BASICS

PUT\$NUMBER\$BUFFER

```
ELSE DO;  
  CALL SEND$BS;  
  A = A - 1;  
  NUM = NUM + 1;  
  COUNT = COUNT - 1;  
END;  
END;  
END PUT$NUMBER$BUFFER;
```

END BASICS;

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